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MECHANICAL ENGINEERING

Mechanical-Engineering Progress in the Petroleum Industry . *E. N. Kemler* 1042

Mechanical Engineering in the Petroleum Industry—A Look Into the Future . . . . . *E. W. Jacobson* 1047

A Comprehensive Appraisal of the Profession . . . . . *S. C. Hollister* 1053

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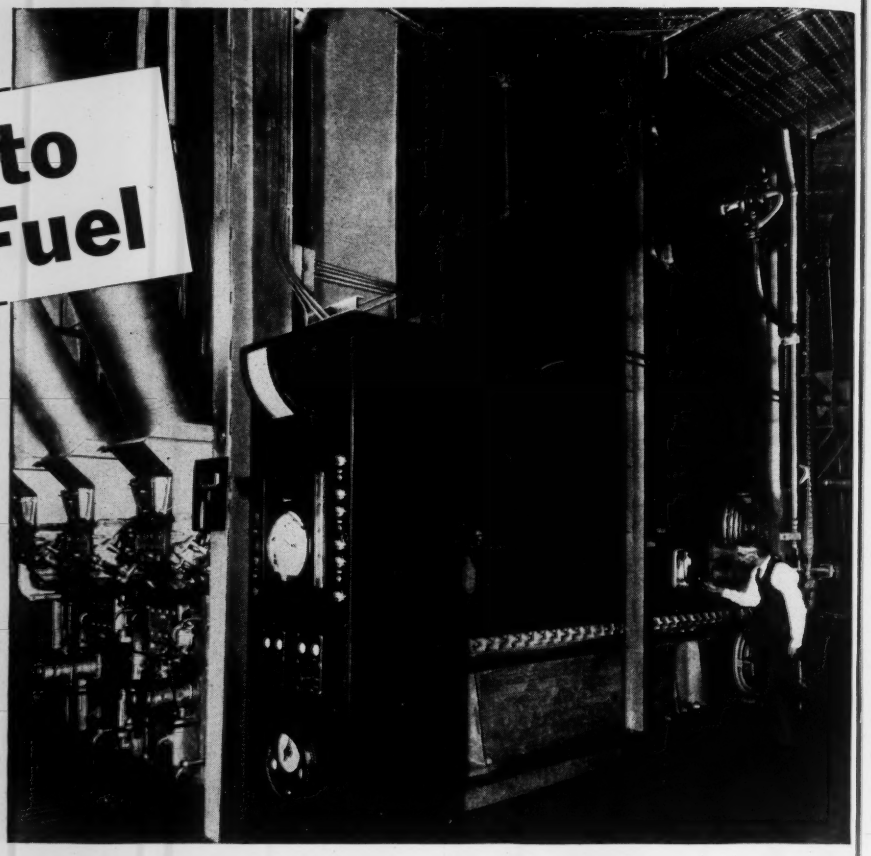
ASME Spring Meeting ◆ Portland, Oregon ◆ March 18–21, 1956

How to Save Fuel



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Electron microscope in new research laboratory . . .

. . . of Jones & Laughlin Steel Corporation permits magnification of steel samples up to 50,000 times, to determine structure of the steel and for study of surface films. The new research laboratory was dedicated in Pittsburgh, Pa., on October 28, 1955.

Editorial

MECHANICAL ENGINEERING

December, 1955, Vol. 77, No. 12 ◆ George A. Stetson, *Editor*

Publications Review

In its annual report to the Council for 1952–1953, the ASME Publications Committee reviewed studies and actions on preprints and periodical publications that had taken place since 1948, when the Society made a drastic change in its publication policy in respect to free distribution of Transactions. Under the plan adopted by vote of the members, Transactions had been placed on a subscription basis, and adoption of the plan eliminated waste in distribution and a saving of about half of the production expense.

Between 1948 and 1953, however, rising publication costs and increase in the number of papers recommended for publication wiped out the saving in expense, and these two factors had a tendency toward continued growth.

At the 1952 Annual Meeting, C. B. Campbell, then chairman of the Publications Committee, reviewed the problems confronting the Committee, and on Feb. 7, 1953, the Committee appointed two of its members as a subcommittee to study the situation in collaboration with the Professional Divisions and other groups. The report of the subcommittee presented on June 11, 1953, suggested: (1) Free distribution of 10 preprints by the coupon method; (2) continuation of Transactions and *Journal of Applied Mechanics* on a subscription basis; (3) a study of the feasibility of grouping Transactions papers; (4) appointment of a review committee; and (5) an effort to overcome any feeling that the Society is limited in its professional interests. This report was referred to the Board on Technology. Action by the Council granting 10 free coupons to every member every year to be exchanged for ASME papers was taken on July 30, 1953, and the first "free coupons" were mailed that year.

Reduction of the appropriation for Transactions in the 1954–1955 budget brought sharply into focus the need for renewed efforts to "solve" ASME publications problems. Hence the subcommittee was enlarged and reconstituted as an Advisory Committee early in 1955. This Advisory Committee has been at work constantly throughout the current year. Its first progress report was submitted to and discussed by the Board on Technology on May 23, 1955. The second was presented to the Board on Oct. 17, 1955.

The first progress report of the Publications Committee included a general statement about the value of Society technical papers and periodical publications and discussed some of the important problems they present for solution. It requested a special appropriation to print papers for which funds had been insufficient, and continuation for the present of pricing and distribution policies now in effect, including the policy of 10 free coupons for every member every year. These requests were granted by the Council.

The report also described five active Committee projects: (1) Devising forms for reporting monthly and annual financial statistics; (2) an improved format for preprints; (3) a binder for preprints; (4) analysis of returns of the 1954 ASME Membership Survey Questionnaire; and (5) improvement in the form used by reviewers.

It listed as subjects of continuing Committee study: (1) Means for educating the sources of papers in putting more value into fewer pages; (2) encouragement of stronger review procedures; (3) grouping and pricing policies for Transactions, *Journal of Applied Mechanics*, and preprints; and (4) improvements in Mechanical Engineering.

The second progress report stated that a form for financial operating statements has been devised and is in use; that the studies of the new preprint format are progressing; that action on the binder for preprints must await crystallization of other general policy matters; that the analysis of some 900 replies to the questionnaire is practically ready for study; and that suggested forms for reviewers are now available for study.

The report directs attention to a proposed revision of the so-called "deadline date rule" reading as follows: "No papers will be assigned to Transactions unless the manuscripts, with illustrations, and recommendations of the sponsoring division or committee are in the Editorial Department by the deadline date of the meeting at which the paper is to be presented, so that preprints from Transactions type can be prepared."

In regard to the difficult question of grouping technical papers so that a member may have easy access to those most closely related to his specialty, the Committee reported for discussion a suggested plan under which "preprints of papers would be grouped by professional divisions and mailed to subscribers prior to the four national meetings of the Society. A suitable binder might well be included. . ."

The Committee realizes that some of the foregoing suggestions affect other committees and current Society procedures. Hence it desires discussion of the proposals, not only by the committees but by members also.

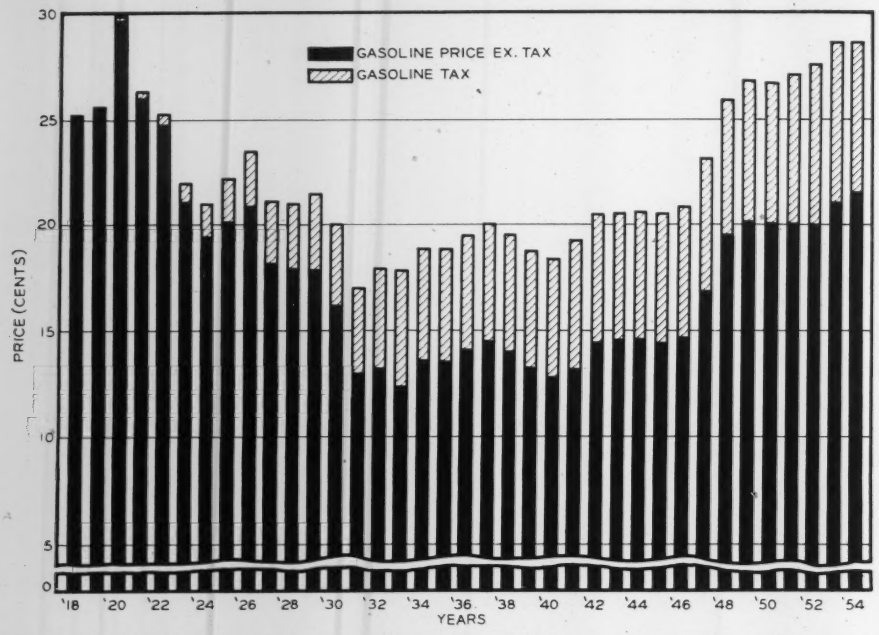


Fig. 1 Retail prices of gasoline, including and excluding taxes—50 representative cities—for the 36-year period 1918–1954

Mechanical-Engineering Progress in the Petroleum Industry

Review of developments in new products—new uses—better service—to meet present-day industrial and social needs

By Emory N. Kemler

Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. Fellow ASME

THE EARLY development of kerosene for lighting was the first major market for petroleum products. The development and general acceptance of the automobile resulted in the demand for gasoline. These two products are the bedrock on which the present-day petroleum industry is based.

Industry's Accomplishment

The integrated nature of a large part of the oil industry has served to focus the attention of all phases of the industry toward meeting the customer needs. In furnishing products to almost every industry, the armed service, and the general public, the petroleum industry comes in direct contact with a large number of people. The yardstick which these people use in evaluating progress in the industry is quite different from that which we would use for an evaluation of technological progress. The customer wants new and better products at moderate prices. The petroleum industry has been able, through its outstanding record of technological progress, to meet this demand. In the face of (1) higher cost of materials, equipment, labor, and taxes, (2) the necessity for drilling and producing from greater depths, (3) the distribution of more products made available at every doorstep through the country, and (4) the furnishing of technical services to the users of its products, the indus-

Contributed by the Petroleum Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

try continues to furnish its products at a cost (not including tax) to the customer less than that of the early 1920's.

Fig. 1 shows the price of gasoline as furnished over a 36-year period as well as the corresponding average federal and state gasoline taxes. The gasoline as furnished over this period of time has also been improved greatly in quality and combustion characteristics. The industry furnishes an almost endless list of products varying from insecticides to rocket fuels, each requiring new processes, equipment, and raw materials. The expansion of the industry into the petrochemical field opens up a new area based on accelerated technological attainments.

The ability to produce a superior product at reasonable cost employing more expensive equipment and labor has resulted from a combination of using the best available technological practices and personnel, and good management. This paper will review very generally some of the important technical advances which have accounted for the industry's accomplishment. The industry will be discussed from the standpoint of exploration, drilling, production, transportation, refining, and marketing. In each of these areas the engineer has been active in design, operation, and new development or research.

The Early Period

The petroleum industry is considered to have had its start with the completion of the Drake Well in 1859. This marked the beginning of active search for petroleum. The oil fields were located on the basis of seepage, or just wild hunch. The drilling and production methods of that period were largely those used for water-well drilling. The transportation was in barrels by horse and wagon, barge, or rail. Refining was by simple distillation. Marketing was unorganized and through stores. Uses were largely limited to crude medicinal products and crude kerosene for illumination.

The general progress in the petroleum industry for the period from 1860 to 1910 was more of an evolution than a planned progress based on technological studies. The exploration and geological phases of the industry made great progress during this period. They developed a rational approach to the location of oil fields. Drilling methods, until the early 1900's, did not change, except for evolving equipment for drilling deeper wells. Rotary drilling was developed in the early 1900's and represented a major development. Until the 1920's, rotary drilling was limited in application largely to the Gulf Coast region with some use in combination with cable-tool drilling in California. A 3000-ft well was still a deep well so that power, hoisting, and operating problems were not sufficiently critical to require the use of any but the most elementary technical principles. Production equipment, except for size, differed little from that of the early days. Wood was still the principal construction material for rigs, derricks, pumping equipment, and tanks. The production practices were based on getting the oil produced as rapidly as possible with no attention being given to conservation practices.

The first casinghead gas was produced in 1903. Pipe lines for transporting crude to refineries represented a major development. The first sizable pipe line was a 4-in. line 60 miles long from western Pennsylvania fields to Pittsburgh, installed in 1874. By 1907, 45,000 miles of pipe line were in operation. Tankers for water transportation furnished the tie between the East, Gulf, and West Coast areas, as well as foreign markets. The first steamship fitted to transport oil was put in operation in 1878. The first tankships of the type we know today were put in operation in 1886. Refining developments consisted largely of improvements in distillation techniques. In 1914 less than 20 per cent of a barrel of oil was converted into gasoline. Marketing practices showed little change. Many general stores had added the gasoline pump to their services offered. The use of gasoline which was to accelerate the growth of the great industry we know today, was just starting to assume its place in the industry.

The Start of Technology

During the period 1915 to 1930, the petroleum industry began to employ and understand the importance and use of technology on an industrywide basis. One major step taken by the industry was the establishment of the American Petroleum Institute in 1919. This industry-sponsored Institute has been very active in the standardization of oil-field equipment. Its activities have resulted in interchangeability of equipment, and indirectly in improved practices and improved equipment. Derricks are a good illustration of the accomplishments of the API standardization program. Prior to the API standards, there were over 400 sizes, styles, and types of derricks without interchangeability, whereas the number was reduced to less than 10 after standardization. During this period there also appeared in this country for the first time, technical books relating to the petroleum industry. These books, while mainly concerned with the then current practices, had a significant impact on the introduction of engineering practices and a wider use of engineers and technologists in the industry. Some of these books are listed in Table 1. Redwood's "Treatise on Petroleum" contains a bibliography of 8804 references on petroleum, dating from the earliest references to about 1920.

The recognition of the value of engineers and technologists in the various operations of the industry led to their increased employment. This increase in technical employees, combined with the increasing complexity of the industry's nature, was soon reflected in professional-society activities. The Institute of Petroleum Technologists was founded in England in 1914. The Petroleum Division of the ASME was organized in 1922. It was developed (1) to promote exchange of information pertaining to mechanical problems in the industry, (2) to provide a common meeting ground for exchange of experience and data for benefit of the individual and industry, (3) encourage research and development, and (4) direct attention to, and recognition for, outstanding achievement in mechanical engineering in the petroleum industry. The American Institute of Mining Engineers set up a petroleum division in 1926. This recognition by these two founder engineering societies is most significant. It is both an acknowledgment of the high quality of technical work done in the industry and of the complex technical nature of its operation and problems.

During this period a number of major oil companies established separate research laboratories to serve the technical needs of their industry. Companies supplying equipment and services to the industry went through similar changes. Sales and service engineers were em-

Table 1 List of References Pertaining to Petroleum Industry

Oil Production Methods—Paine and Stroud, Western Engineering Publishing Co.	1913
American Petroleum Industry (2 vols.)—Bacon and Hamer, McGraw-Hill Book Co.	1916
Handbook of Casinghead Gas—Westcott, Metric Metal Works	1916
Oil and Gas Production—Johnson and Huntley, John Wiley and Sons, Inc.	1916
Petroleum Production Methods—Suman, Gulf Publishing Co.	1921
Deep Well Drilling—Jeffrey, Gulf Publishing Co.	1921
Handbook of Petroleum—Day, John Wiley and Sons	1922
Petroleum Refining—Bell, McGraw-Hill Book Co.	1923
Oil Well Drilling Methods—Ziegler	1923
Natural Gas—Lichty, John Wiley and Sons, Inc.	1924
Petroleum Production Engineering—Uren, McGraw-Hill Book Co.	1924
The Oil Industry—Lilley, D. Van Nostrand Co., Inc.	1925
Oil Field Exploration and Practice—Thompson	1925
Natural Gas Handbook—Diehl, Metric Metal Works	1927
Petroleum and Its Products—Gruse, McGraw-Hill Book Co.	1928
Production of Oil, Gas and Water—Herold, Stanford University Press	1928
Petroleum (3 vols.)—Redwood, Griffin and Co. (London)	1922
Oil Field Development and Petroleum Mining—Thompson, Crosby, Lockwood and Son (London)	1916
Popular Oil Geology—Ziegler, John Wiley and Sons, Inc.	1920
Prospecting for Oil and Gas—Panyity, John Wiley and Sons, Inc.	1920
The Petroleum Industy, Institute of Petroleum Technologists	1922
Petroleum Mining—Thompson, Crosby, Lockwood and Son (London)	1910
Business of Oil Production—Johnson, Huntley and Somers, John Wiley and Sons	1922
Petroleum Refining—Campbell, C. Griffin and Co. (London)	1918
Field Methods in Petroleum Geology—Cox, Drake and Muckenburg, McGraw-Hill Book Co.	1921
Oil Finding—Craig, Arnold (London)	1920
Handbook of Petroleum, Asphalt and Natural Gas—Cross	1919
Geology of Petroleum—Emmons, McGraw-Hill Book Co.	1921
Practical Oil Geology—Hager, McGraw-Hill Book Co.	1919
Oil Field Practice—Hager, McGraw-Hill Book Co.	1921
Technical Examination of Crude Petroleum, Petroleum Products and Natural Gas—Hamor and Pagett, McGraw-Hill Book Co.	1921

ployed by these organizations and many of them organized research departments and expanded their design and development staffs. By the start of the 1930's we find that technology had demonstrated to management of the industry what it could offer. Since that time, technology has been applied at an ever-increasing extent to the solution of the problems of the industry, its suppliers, and its customers.

Recent Progress

Introduction. Both the size of the petroleum industry and complexity of its operations make it difficult to evaluate its progress briefly. Reference to Table 2, which indicates the growth of the industry in so far as production is concerned, shows that since the early 1920's production by the industry has increased more than sixfold. Its capacity to produce has increased even more rapidly. The production of natural gasoline and LPG products serve to remind us that during this period the industry has made much progress in the direction of conservation. Prior to this period these were essentially waste products. Progress in transportation technology has made economical the delivery of natural gas, mostly for residential use, to many previously inaccessible areas. Petroleum products have largely passed from the convenience class to the necessity class.

Another over-all picture of the magnitude of the petroleum industry is given in Table 3. Here is listed the estimated investment in the various phases of the industry. The total investment of approximately forty-billion dollars places the petroleum industry high in that of

Table 2 Production in Petroleum Industry

Year	Crude production (1000 bbl)	Natural gasoline prod (1000 bbl)	Natural-gas prod (1,000,000 cu ft)	LPG sales (1000 gal)	Oil reserves (1000 bbl)
1860	500				
1870	5261				
1880	26286				
1890	45824				
1900	63621				2900000
1910	209557	180	509155		4500000
1920	442928	9160	798000		7200000
1930	898011	52631	1943421	18017	13600000
1940	1353214	55700	2660222	313456	19024515
1950	1973574	181961	6282060	3482567	25268398
1954	2316323	248136	9426509	4932009	29560746

Table 3 Estimated Investment in Petroleum Industry

Estimated investment (billions of dollars) (1954)	
Drilling and production	22.3
Transportation	4.3
Refining	6.4
Marketing	4.0

American industry. The petroleum industry ranks fourth among the American industries, with agriculture, railroads, and public utilities representing larger investments.

The petroleum industry's technical problems cut across many areas of science. The engineer in the industry is, in general, responsible for a technical area much broader than that covered by any given professional group. His activities, in general, will depend on his specialization and company size. It is, therefore, difficult to outline just what might be covered by a mechanical engineer. The industry, employing as it does, engineers, scientists, and technologists from all areas, inevitably has a considerable overlap of activities. In the refinery field, for example, the division of activities of the mechanical and chemical engineer is not very sharp. In certain phases of the activities, both may be concerned with equipment problems, heat-transfer problems, and so forth. The same holds true as between the petroleum engineer and the mechanical engineer in the production and drilling areas. The following discussion, therefore, attempts merely to point out the accomplishments, particularly in areas of general interest to mechanical engineering, but also including major areas of technological accomplishment.

Exploration. In the area associated with location of petroleum the mechanical engineer has, in recent years, been actively engaged in designing and developing new types of transportation to make it possible to explore such areas as the swamps of the south and the muskegs of the Canadian plains. He also has had a part in the design of some of the instrumentation utilized for exploration work. One of the interesting geophysical developments was the flying magnetometer which was used for submarine location during World War II. In addition to the development of more versatile instrumentation, there has been the need for adapting geophysical methods for offshore exploration. This has been done quite successfully. Improvements in instrumentation, techniques, and interpretation methods have greatly contributed to the increase in petroleum reserves.

Drilling. The developments in drilling have been in the direction of permitting drilling to greater depth, reduced cost, increased drilling rates and, more recently,

the adaptation of drilling to offshore development. The deepest well to date is the Ohio Oil Company well in California of 21,482 ft, abandoned this year. This well demonstrated that mechanical equipment had been developed capable of drilling wells over 20,000 ft. In addition to heavier-duty equipment for deeper drilling, much attention has been given in the past decade to increased drilling rates. The jet bit has been developed for Gulf Coast operations and has given exceedingly high drilling rates. A large part of the successful operation of rotary drilling for general use resulted from the development of bits for hard formations. The drilling rates for hard formations are still very low. Current developments aimed to improve rates for harder formations include rotary percussion methods, sonic methods, and use of magnetostriction units. Other important drilling developments include adaptation of air drilling for deep wells, development of automatic-control equipment for reducing the degree of manual operation required, and the general improvement in the design of power and hoisting equipment.

The pressures encountered in drilling are normally about $^1/_2$ psi per ft, or 10,000 psi for a 20,000-ft well. Equipment manufacturers have developed well-head equipment to withstand these pressures. Manufacturers of casing and drill pipe also have developed alloy materials to handle these depths. The development of muds to fit a wide range of drilling conditions has likewise been an important factor without which it would be impossible to drill many formations.

Many new logging techniques have been made available for exploring the open hole. Gun perforators which can be run in small pipe have made possible new completion methods. The drilling activities have available a large number of specialized services such as electrical and radioactive logging, mud, perforating, cementing, and so on, all of which have been developed or have shown major improvements during recent years.

The extension of exploration to the offshore area of Louisiana and Texas has been made possible by outstanding engineering accomplishments in offshore structure, barge and service-vessel design, and in adaptation of operating practices to fit the difficult offshore problems.

Production. Production activities can be divided into two phases—(1) The problems associated with the mechanical lifting and handling of the oil and (2) the mechanics of the reservoir and its operation. The basic methods in pumping show little change since the early wells. The walking-beam mechanism of Watt is still used on modern pumping units, and sucker-rod pumping is used on most of the 514,000 producing wells requiring artificial lift. Alloy steels have been developed to withstand the high stresses and corrosion-fatigue conditions. The modern gear-reduction self-contained pumping unit represents a great improvement over the belt-driven wooden-rig fronts. Hydraulic pumping systems have been developed which are adaptable to a wide range of production requirements. In this system power oil under pressure is transmitted to the bottom-hole pump, thereby doing away with the sucker rods. One system has been developed which permits recovery of the bottom-hole pump by reversing the hydraulic flow. This represents an important development in reducing operating costs. Hydraulic long-stroke surface units also have been developed to replace the conventional pumping unit. These units are adaptable for strokes up to 25 ft.

Considerable attention has been given to automatic operation of production equipment. Pumping units have been equipped for automatic start and stop, and tank batteries have been equipped for automatic operations. Automatic operation of offshore installations becomes important from a safety as well as an operating standpoint. Some consideration has been given to piping oil and gas from the well to shore before separation.

Conservation has received increasing attention. Early production practices involved getting out the oil as rapidly as possible. Superstition, lack of knowledge of how a reservoir behaves, and the desire to convert the oil to money as rapidly as possible, all lead to the use of this uneconomical practice. Early production men believed that to shut a well in would ruin it. The development of rational conservation practices has closely followed the expansion of our knowledge of reservoir performance.

Research on the flow of fluids in reservoirs was well under way by 1930. The principles of reservoir behavior were understood by only a very few at that time. The area of reservoir engineering has extended greatly since that time and has been the most important factor in bringing about better practices. Engineers have made use of such techniques as electrical analogs and modern computers as well as basic analysis in their extension of this work. The application of modern reservoir practices has resulted in greater recovery, lower gas-oil ratios, longer flowing life, and lower lifting costs, as well as greater conservation.

The increase in knowledge of reservoir behavior and in the properties of reservoir fluids has also brought about other practices which lead to greater recovery. These include rational application of waterflooding, repressuring, pressure maintenance both through gas and water return to the reservoir, hydraulic fracturing of the reservoir rocks, and in situ combustion. Many old fields have gone through several stages of rejuvenation. Development of new techniques may make further exploitation of many old fields economical.

Transportation. Pipe lines and tankers, in early use in the history of the petroleum industry, continue to be the important means of petroleum transportation. The past quarter century has seen much attention being given to the transportation of products. Perhaps the most attention has been given to the automatic operation of pumping stations and in the automatic metering and control of the product at the delivery point.

The natural-gas industry has shown a tremendous growth since 1930. This has largely been due to the development of techniques and equipment for manufacture and operation of large-diameter lines. Over 450,000 miles of pipe lines have been built to serve the natural-gas industry. This includes lines up to 36 in. diam. The development of high-yield-strength thin-walled pipe has made it possible to transport the gas economically. Some of these lines are quite long. In one case a line runs from the Mexican border to New England. Increased costs of gas, operations, and new installations, together with longer lines has resulted in some increase in price to the consumer.

The transportation of crude shows little general change, except for the introduction of automatic operation. The transportation of refinery products has expanded greatly during recent years. The handling of a variety of products in a line has necessitated developing techniques for identifying the products en route. Radio-

active techniques have been successful for this purpose. One important development has been in the field of metering and measurements. Here co-operation with the ASME Fluid Meters Committee activities, the ASTM standardization committees, the API committees, and the various company and university laboratories and engineers has brought about important developments.

The Inter-Provincial-Lakehead crude line from Edmonton, Alberta to Sarnia, Ontario, is a recent installation which illustrates some of the problems of modern crude trunk lines. This line is 1765 miles long, the world's longest. Oil can be transported from Edmonton to Sarnia at a cost of 64 cents per barrel. The 645-mile Lakehead portion is 30 in. diam, and cost $74,000,000. It involved laying two 20-in. 21,000-ft-long lines under the Straits of Mackinac at depths as great as 230 ft below the surface. It requires a total of 2,800,000 bbl of oil just to fill this 645-mile section.

The offshore developments have required the develop ment of techniques of laying gas and oil lines from the offshore installations. While crude could be handled from offshore installations by barge, gas could only be economically handled by pipe line. The techniques and methods used in design and installation of offshore oil and gas lines have been quite successful. It will be necessary to develop methods for serving platforms at points further from shore and in greater water depths.

Refining. The developments in refining include processes to give greater gasoline yields, lower costs, automatic operation, and generally improved products. The petrochemical industry–an extension of refining–is just in its infancy. It can be expected to grow rapidly and will extend the demand for crude petroleum.

Cracking was first used to give an increase in gasoline yield. As demand for gasoline increased, more attention has been given to processing techniques which would give better utilization of the crude. These processes are quite complex and in general utilize a catalyst. They operate at high pressures and temperatures, i.e. pressures up to about 800 psi and temperatures as high as 1000 F. Equipment design for these applications is both difficult and complex. The result of these improvements in processes has been to increase gasoline recovery from 20 to 45 per cent.

The types of processes which have found extensive use include catalytic cracking, reforming, polymerization, alkylation, and desulphurization. Catalytic cracking and reforming processes are used in about half of today's crude refining. The various processes utilize a great number of variations. In the case of reforming processes these include such variations as platforming, catforming, houdreforming, ultraforming, uniforming, hyperforming, hydroforming, sovaforming and rexforming. The objective of the various processes is to upgrade petroleum liquids. Recent activities also include the development of catalytic processes such as polymerization and alkylation for the production of liquid fuels from waste gases. Modern refinery and petrochemical processes basically utilize the crude petroleum or natural gas as building blocks which are broken down and rebuilt in the process to give the desired end product.

The use of fluidized catalytic beds represents a significant development. This makes it possible to replace batch processing with continuous-flow processes. The batch or cyclic processes also have been improved through introduction of controls, and through combination with other processes to reduce intermediate storage and heat losses. Methods of liquid and gas waste disposal have been developed to minimize atmospheric and stream pollution.

The complex nature of a refining plant, together with the relatively large space required, leads to the use of automatic controls. Without automation, it would be essentially impossible and very dangerous to attempt to operate such a plant. Graphic panels are used to permit control at a central point.

New materials have played an important part in making a modern refinery possible. High pressures and temperatures, plus corrosion problems, in many cases rule out most materials for refinery uses. Research on creep, fatigue, embrittlement, corrosion resistance, as well as static properties, has contributed much to the development of adequate materials.

Distribution. The markets for petroleum products present a continually changing pattern. Gasoline continues to be a major one, accounting for about half the demand. Use of petroleum products for fuel purposes has been on the increase. In 1954 there were 7,600,000 homes using oil burners and 22,000,0000 natural-gas customers. A total of 58,100,000 motor vehicles, together with 4,700,-000 farm tractors were using petroleum products. The number of railroad diesels had increased to 23,700 by the end of 1954. The supplying of diesel and fuel oil for marine uses, use of fuel oil and gas for industrial plants, and supplying of road oils represent other large uses. The industry also supplies thousands of packaged and bulk products for the factory and home. The delivery, storage, and marketing of these products involves many engineering problems. Better metering equipment, service-station equipment, and terminal facilities have required new engineering developments.

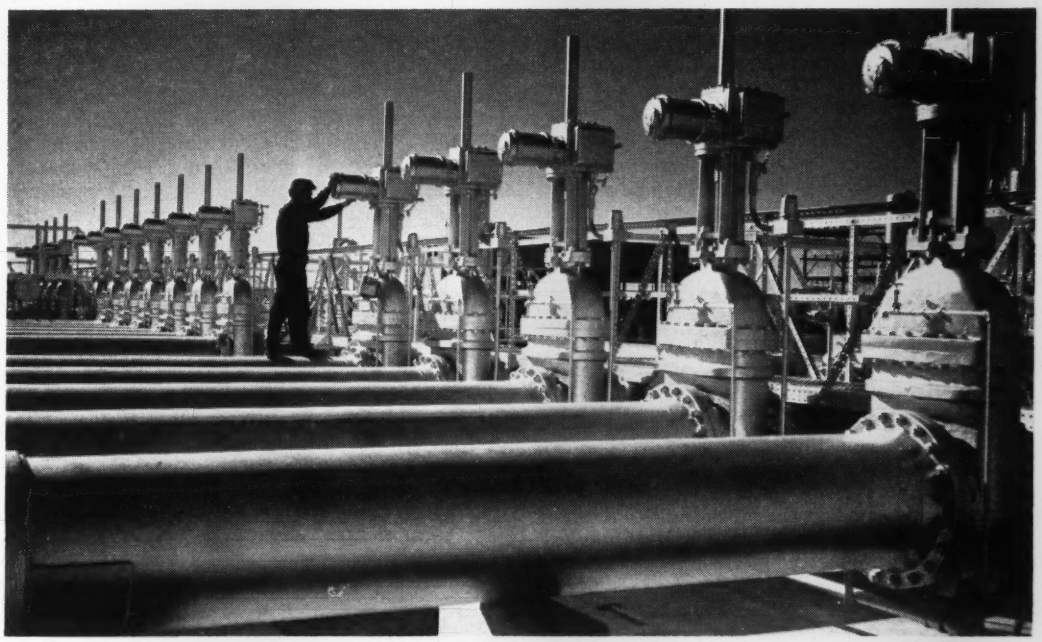
The Mechanical Engineer's Role

The problems of the various phases of the petroleum industry with which the mechanical engineer is associated require the application of the principles, techniques, and information from essentially all the areas of applied science. Drilling, production, transportation, and refining operating groups all need information from such areas as mechanics, applied elasticity, fluid mechanics, heat transfer, thermodynamics, machine design, automatic control, servomechanisms, electronics, electrical design, chemical-process design, instrumentation, soil mechanics, structural design, metallography, and corrosion. The offshore activities have added the necessity of a knowledge of such subjects as oceanography, meteorology, wave mechanics, and marine biology. The research groups which serve the operating units draw upon all the areas of science for the development of new products, processes, and practices. They are also concerned with extending our knowledge of the basic processes and phenomena involved.

All of the operating groups have made great progress in the area of automatic operation. In some cases such practices are important to insure economical operations; in others such as refineries, automation is necessary for proper process control and for safety.

The offshore developments have been made possible by outstanding engineering design and ingenuity. Here technology has brought into reality a petroleum reserve previously thought to be inaccessible. The engineering and research departments of those industries

(Continued on page 1055)



Piping and valves at a terminal on Gulf Oil Corporation's West Texas Gulf Pipe Line. Size of line 26 in. with capacity of 301,000 barrels of crude oil per day.

Mechanical Engineering in the Petroleum Industry . . .

. . . A Look into the Future

by Eugene W. Jacobson

Chief Design Engineer, Gulf Research and Development Company, Pittsburgh, Pa. Member ASME

FUTURE progress in the petroleum industry will depend heavily on advancements in mechanical engineering. Expenditure of funds for mechanical equipment and plant being a great portion of the total oil-company budget, costsaving improvements in either mechanical equipment or methods will find early application and ready acceptance in all branches of the petroleum industry. Immediate as well as long-range improvements of methods or processes depend upon strong mechanical-engineering research and a development program aimed at getting the best equipment and plant at the lowest cost. This will insure that improved equipment will be available for the new processes and methods.

Contributed by the Petroleum Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Research—Hope of the Future

Research with its enormous leverage in producing sound development is the major factor that has achieved progress in the past; it now provides the only sure basis for future progress. The petroleum industry, which had its beginnings on the initiative, ingenuity, and perspiration of its early workers, kept pace without too much difficulty with the mechanical needs it opened up because most of the problems were solved empirically; and there was great demand for its products. Increasing difficulty in finding and producing oil and mounting performance requirements for its products have dictated that management use the research approach because the empirical method is no longer sufficient. Now both large and small organizations within the industry are engaged actively in research.

Research and development work in industries outside the petroleum industry can contribute heavily to advancements in petroleum-mechanical engineering. A look at the major divisions of mechanical engineering will inevitably point out the diverse fields where new developments may be expected. Of great importance will be the work on new materials of construction. One major company, in the power-generation-equipment field, just establishing a new and separate research center for the study of materials, believes its future business depends on its ability to come up with stronger, longer-wearing, easier-machined, and formed metals. Intensified research activity is taking place in heat transfer, fluid flow, gas turbines, flow measurement, and power generation. These are just a few of the major branches in mechanical engineering where advanced technology also will apply to petroleum technology.

Within the petroleum industry, management must look to the perception and initiative of its mechanical engineers to take advantage of the mechanical developments in other industries. The value of developments in other fields must be grasped by the oil-industry engineer, who can then adapt these concepts to the specialized problems in his own industry. Participation of the petroleum-industry mechanical engineer in the affairs of the ASME can best bring him in contact with new developments as they appear and are reported. Group discussion in the ASME sponsored forum with mechanical engineers from various industries leads inevitably to stimulation of thinking about ways of applying the new concepts to the benefit of the engineer's own problems. This 75th Anniversary of ASME is serving as a new stimulus for the Society, and the future undoubtedly will bring out many new and useful ideas applicable to petroleum.

Finding Oil Fields

In finding oil fields, the mechanical engineer has not been considered to be a major contributor. However, traversing much of the difficult terrain overlying oil deposits at reasonable cost has been made possible with his aid. Equipment has been developed by the mechanical engineer during the past decade for traversing the swamp, marsh, and muskeg regions so that geophysical parties could get into these areas for gravity and seismic measurements of subsurface properties exposing the likely spots for oil deposits. Light portable equipment has been developed by the geologist, geophysicist, and the mechanical engineer working as a team.

An example of one of the most recent transportation vehicles to be developed is the "Bombardier" muskeg tractor which has made possible rapid geophysical exploration activities in the Canadian muskeg areas. Air-borne geophysical instruments requiring a high degree of mechanical ingenuity in their design are eliminating the tedious and slow work of making magnetic surveys over mountain, jungle, desert, and other difficult areas. New geophysical instruments are being developed of lighter weight and increased accuracy to meet new needs for portability and precision of measurement.

Drilling Oil Wells

In oil-well drilling, the first mechanically minded man to apply his genius was "Uncle Billy" Smith, a skilled toolsmith, blacksmith, and salt-well driller. The ingenuity of Smith, coupled with that of Edwin L. Drake, who conceived the idea of using pipe casing to get through the soft overlay over the rock, bore fruit in the first successful oil well at Titusville. Since that first well, engineers have continually been busy improving methods and tools for drilling wells. Now emphasis is being placed on the development and use of such things as "jet" and "button" bits, streams of compressed air or natural gas, percussion and sonic drills, slimmer holes, new drilling fluids and new equipment to test wells and get them into production.

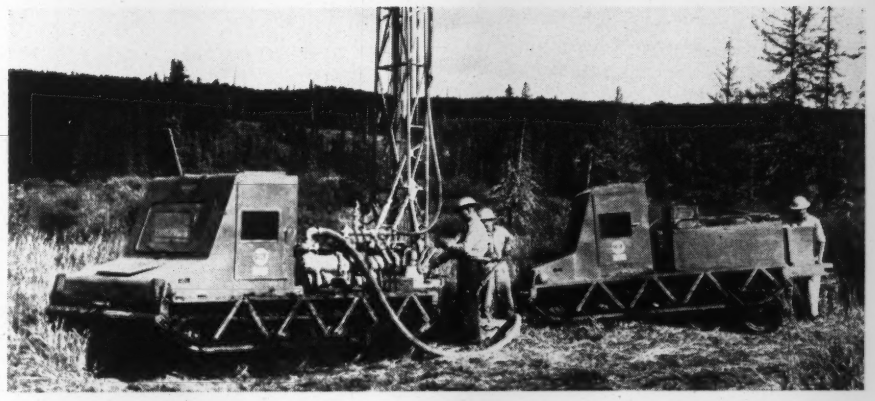
A growing number of oil men see cost-cutting possibilities in "slim" or small-diameter holes. Claimed for the slim hole are (1) lighter surface equipment, which is easier to move around, and can be operated with fewer personnel, and (2) use of less cement, mud, and other materials that go into the hole. The button bit for drilling through hard rock is fast growing in popularity. Instead of the usual cutting teeth, the business end of this bit is covered with several hundred little knobs of tungsten carbide about the size of a pea sliced in half. Penetration up to five times faster than a conventional bit is claimed.

Not all this study is being done in the oil industry. One promising design of an oil-well drill is being developed by Borg-Warner, a well-known name in the auto industry. This drill is the Bodine sonic oil-well drill. It uses the mud flow to drive a hydraulic turbine that turns a series of unbalanced weights at high speed. Vibrations set up in the drill are imparted to the bit with such force that good penetration rates are being reported to be secured through the hardest rock formations. Other types of percussion drills using energy from the drilling mud show promise. Supersonic vibration generators are being considered. Surprising results may be forthcoming in the not-too-distant future.

Portability of surface well-drilling equipment has been a continual problem through the years. Stronger steels and lightweight power-generation and transmission equipment have been adapted quickly to drilling rigs. The struggle is to use slimmer holes, higher-speed drilling tools, and the like, to shave the cost of drilling. In the deeper holes a big problem has been keeping the hole straight. The rapid development of the use of gas instead of mud for removing the cuttings from the hole opens up a whole new field of possible developments. By the use of suitable instrumentation, stresses in the drilling equipment can be controlled within safe limits so that the maximum possible usefulness can be obtained without failure of the equipment. This phase of the problem offers challenging opportunity to the mechanical engineer.

Producing Oil From Wells

Producing oil from the well, once the well has been drilled, presents a continually changing set of problems from start of oil flow, through the period it fails to flow and must be pumped, till it becomes uneconomical to produce at all. Design of casing strings to withstand external pressures at the bottom of the well and high internal pressures at the top of the well often requires careful study. Joints must be designed to prevent leakage as well as to develop as nearly full strength of the casing as possible. Often casing and equipment must be designed for production of two or more zones



Two of the newly developed Bombardier muskeg tractors, which are doubling or tripling the speed with which vast areas of northern Canada are being explored for oil, in use in seismic prospecting

at the same time and still keep the produced oil separate for each zone.

Conditions are encountered in producing sour-condensate wells which require intensive research to discover reasons for unaccountable and unforeseen failures of pipe, valves, and other equipment used. Selection of materials not subject to sudden failures in such well environments presents a constant challenge. When a well must be pumped, a wide variety of pumping equipment is available from which the engineer must pick the most desirable from a cost standpoint.

Offshore Problems

The development of offshore oil deposits is just getting a good start with costs at present in excess of the immediate profits from offshore production. Engineering problems are great and start with the design of structures which will withstand the forces of waves and winds during the tropical storms which occur intermittently in the Gulf region. Estimates of wave forces have hitherto been inaccurate. Better interpretation of data on wave forces, construction costs, and operational requirements through continued study will provide better offshore structures. Research work now in progress should make possible sensible and reasonably safe designs. Many new ideas are being tried in designing both fixed and portable well-drilling platforms.

Considerable progress has been made in developing suitable floating equipment. The DeLong method for elevating a floating platform out of the water by climbing up a set of piles shows good promise in portable-platform design. A problem of tremendous importance but still not solved satisfactorily is that of transferring crews to and from drilling platforms or barges in rough weather. Helicopters have limited capacity and cannot operate in foul weather. Transferring personnel from small boats is tricky and dangerous even with moderate ocean swells. Once the offshore well is producing, the job of treating and removing the oil, along with controlling and servicing the well, presents an urgent group of problems for the mechanical engineer.

Redevelopment of Old Fields

The redevelopment of the older depleted oil fields offers promising opportunity. The hydrafrac process, which uses hydraulic pressure to open flow passages in oil-bearing formations, is relatively new and is astounding oil and gas men all over the country. Fields which are almost one hundred years old leap to new life when hydrafraced. Gas wells, even some which have been completed and abandoned as dry holes "on structure," or even off structure entirely, may turn into commercial and relatively long-lived wells after being hydrafraced. These are in a part of Pennsylvania and New York which for years was supposed to have been drained of gas.

It is not hard to imagine the tremendous possibilities of new applications of the principles of hydraulics such as this hydrafrac process in producing more from the old submarginal fields. Horizontal drilling has been tried. Will not the ingenuity of the mechanical engineer find wonderful application in redevelopment of the old fields?

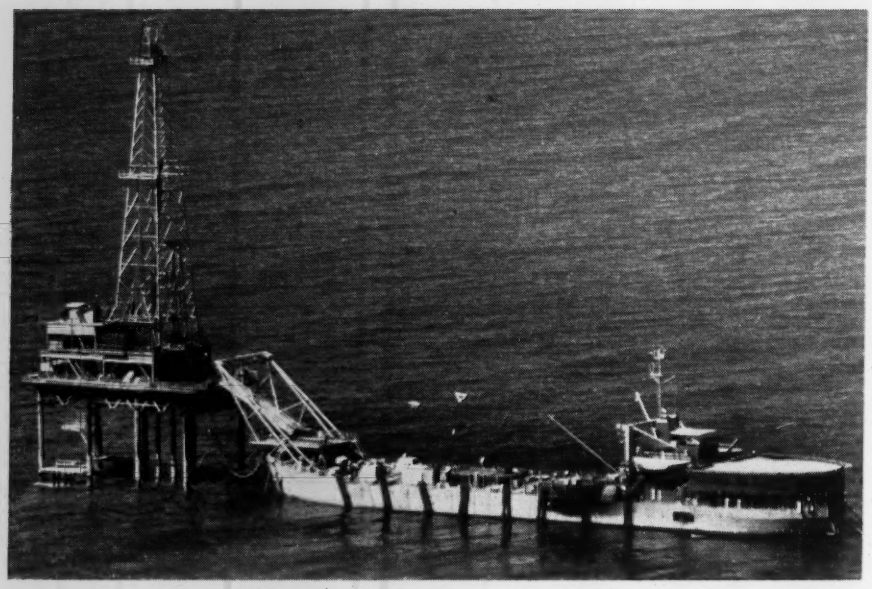
Pipe-Line Transportation of Oil

Pipe-line transportation has experienced great engineering advancement in the past decade. Larger and longer pipe lines are being planned and built. Pumping stations have become automatic and remotely controlled. Measurement with positive-displacement meters has removed the cost and inaccuracy of tank gaging for pipeline oil and cut down on the number of storage tanks required. Conservation of petroleum products by both closer accounting with meters, and improvement of storage-tank design to reduce evaporation losses, has been a major contribution to costsaving in pipe-line operations.

Powering pipe-line pumps has been a battle of economics between electric motors and diesel engines, with a third type, the gas turbine, making a strong bid for favor.

Major improvements in present power plants for pumping stations may not be as startling in individual instances as in the past, but will likely be in the form of a series of smaller yet significant improvements to increase efficiency and reduce operating cost.

In the field of pumps, the centrifugal seems to retain the upper hand costwise. Some recognition has been retained by the reciprocating pump through increase in speed, improvement of cylinder inlet and outlet-passage design, and variable-stroke and pressure-control devices. Large rotary-gear pumps suffer on first cost



The derrick and rig, platform, and drilling tender, a converted LST, which are being used to drill wells for Gulf Oil in the Tidelands

and on maintenance. With centrifugals the hydraulic problems of pulsations and shock are minimized, allowing the use of thinner walled pipes.

Improvement in instrumentation for operation of pipe lines has been phenomenal. Such simple devices as the Gulf electronic interface detector and the "measured-mile" (Shell) method for proving meters show what engineering thinking can produce in the way of cost-cutting improvements in pipe-line transportation.

Many of the significant developments in pipe lines have been first applied in product pipe lines. Many of these now are, and others in the near future will be, applied in pipe lines for crude oil. The sand, wax, and hydrate problem in positive-displacement meters for measuring crude oil in pipe lines is nearer solution. The Joint ASME-API Petroleum PD Meter Committee is attacking the measurement of crude oil with PD meters vigorously, so that standard practice in this method should be forthcoming soon. Economical separation of the gas and entrained solids in crude oil is, and will continue to be, a major problem.

Processing and Refining Oil

In the field of petroleum processing lie extensive applications of mechanical engineering. With the rapid pace of development of new processes both for the production and improvement of motor fuels and in petrochemicals, the design of the pressure vessels, piping, instrumentation, heat exchangers, insulation, and so on, to contain and control the processes offers challenging opportunity. The success or failure costwise of many a process is determined by the close mechanical design of the process equipment.

In an earlier paper,[1] the author discussed the future outlook in pressure-vessel design. In this field the mechanical engineer will be the key figure in developing ways and means of applying the new developments in materials to pressure-vessel use. The research engineer undoubtedly will develop a better understanding of the mechanism of creep, and from the work in the field of solid-state physics, a better knowledge of causes of failure of materials under stress and how to design to avoid such failures. The need for larger and larger process vessels poses new problems in field welding and in both transportation and erection of these vessels in the field. In the large catalytic-cracking units the control of two and three-phase fluid streams for rate of flow, freedom from dangerous vibration, and effective transfer of large quantities of heat needs sound and imaginative engineering.

Power and Utilities in the Refinery

The mechanical engineer skilled in power production and utilization finds wide use for his talents in the refinery where considerable electric power and steam are used. Steam for power and for the processes at required pressure and temperature, must be produced at the lowest possible cost. Some refineries find it economical to generate low-pressure steam for process and purchase all their power requirements, and there are other useful combinations.

A large item in the work of the utilities engineer is water-treatment for both boiler and cooling-tower make-up. Continual study of the individual over-all heat balance with process requirements permits the utilities engineer to make worth-while costsavings in power and heat. There is an extensive and potential economic job in the interplay and evaluation of the many factors involved. Holding maintenance costs low on equipment for both utilities and process requires almost ceaseless engineering attention.

[1] "A Look Ahead in Pressure-Vessel Design in the Petroleum Industry," by E. W. Jacobson, ASME Paper No. 54—PET-9. Published in *Petroleum Refiner*, vol. 33, no. 11, Nov., 1954, pp. 148–155.

Instrumentation

Automation, a much-overworked term, is not new to petroleum technology. The engineer is a key figure in design and operation of instruments for production, transportation, and refinery plant. As an example, flow measurement, always a major problem, is of key importance in economical operation. Choice must be made often between the various types of inferential meters such as orifice, venturi, or pitot tube. These register by means of a differential pressure created across the element inserted in the stream. The selection problem becomes, then, one of obtaining sufficient differential pressure to measure accurately the lowest flow anticipated and at the same time accommodate the large differential pressure created by the maximum flow expected. Keeping low the irrecoverable pressure drop across the instrument, securing speed of response and accuracy, and elimination of pulsation, are, and will continue to be, problems.

The Fight Against Corrosion

The mechanical engineer will find himself deeply involved in the fight against corrosion. In refineries alone, corrosion is estimated to be costing as much as a quarter of a billion dollars a year. Engineering staffs charged with responsibility for saving part of the heavy losses now suffered from corrosion are taking on broader functions. Better correlation of corrosion data is needed on which to base study of remedies for individual cases of corrosion. Close study of conditions and careful selection of metals for the various types of corrosion conditions are desirable. Of utmost importance is the close co-ordination of the available knowledge and skills both in company staffs and outside contractors' staffs to avoid corrosion trouble in new plants and equipment.

Marketing Petroleum Products

Mechanical problems in the marketing branch of the industry will be those involved in reducing cost of packaging, handling, and dispensing products. In the service station, there has been a continuous improvement in gasoline-dispensing equipment and car servicing. The positive-displacement meter, the heart of the gasoline-dispensing unit, does quite a creditable job of driving the complex computer mechanism while measuring the gasoline. However, recent research by the author's organization indicates that even the best present meter can be improved considerably. It has been shown to be possible for a meter to be so designed that the change in displacement from wear can be compensated by the effects of wear so that the accuracy of measurement is unimpaired with use.

With improvements in design and manufacturing procedures, the average meter might be made to last several times as long and need little or no attention or calibration throughout its service life.

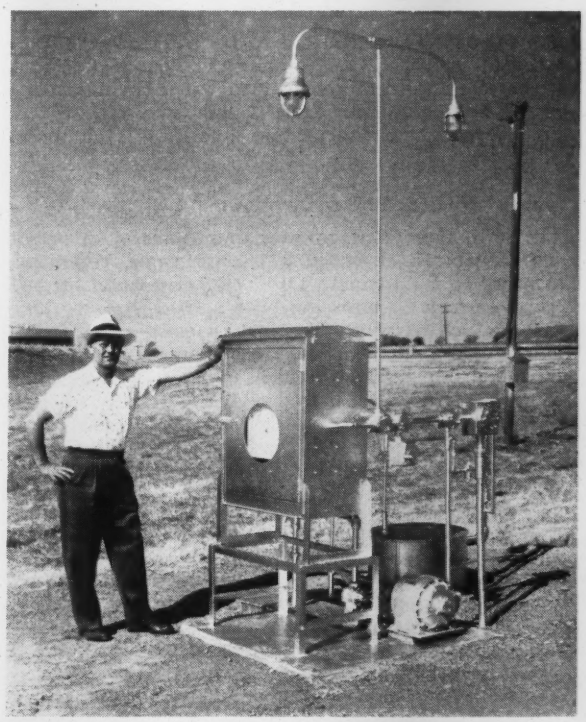
Speed of servicing customers' cars could be greatly increased were auto gasoline tanks designed for fast reception of fuel. The proper sizing of service-station fuel storage-tank fill and vent lines can reduce materially the time of the delivery truck in filling the tanks. Even the station air-compressor unit may come in for its part in costsavings through testing and selection of the best unit, where as much as the original cost of the unit may be saved in an average unit's life by lower power consumption and maintenance of one design as compared to another.

The designs of many bulk stations have been streamlined to speed up loading. Bottom loading of trucks is being tried and may prove practical at least in some instances. Remote ticket-printing registers on meters have simplified the accounting, and improvements in meters have increased their accuracy and decreased maintenance requirements. More general application of the best features of the various new bulk-station designs can be expected.

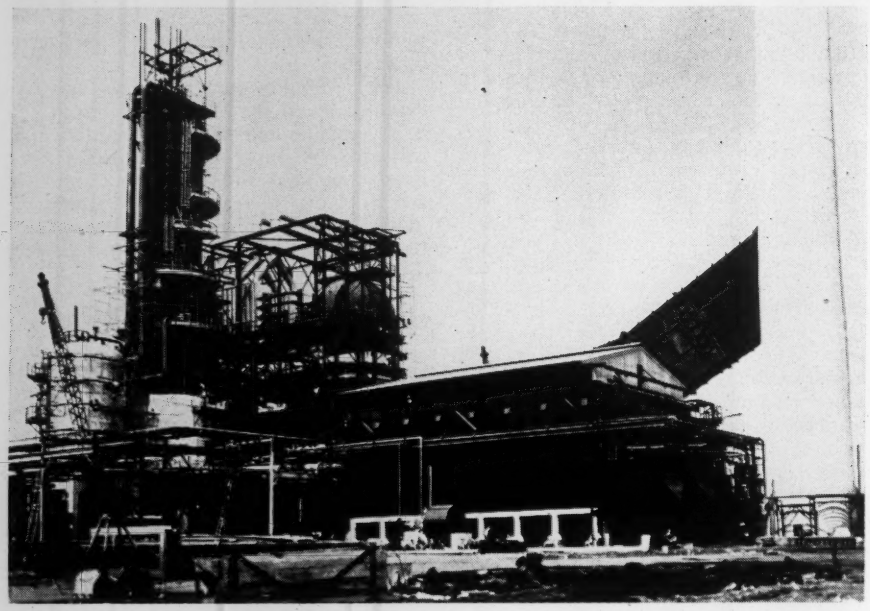
Evaluation of Petroleum Products

In the evaluation of petroleum products lies a rather large field for mechanical engineering. The modern petroleum research laboratory needs to be well equipped with special mechanical devices for performance testing products all the way from thick transmission grease to aviation gasoline. All of the new developments in petroleum products need to be tested in conditions as like as possible to field use. A great deal of mechanical-design ingenuity and close machining skill are required to produce controlled conditions in a testing machine so that tested differences between two different product samples will show greater contrast than will a single product sample when tested in two supposedly identical test machines.

The rate at which octane values of premium-grade motor fuels are advancing today emphasizes the need for some modification or revision of the presently accepted



Instrumentation for electronic interface detector, a device which enables handling of multiple products in pipe lines with greater efficiency and economy



Recently completed at the Gulf Oil Corporation Philadelphia Refinery is the world's largest atmospheric and vacuum distillation unit with a capacity of 125,000 barrels a day. This plant will make gasoline, heating oils, and charge stock for the catalytic-cracking unit.

laboratory methods for measuring antiknock ratings. Actually, there are two needs: One for methods to get beyond the present limit of 100 octane, and the other for methods that are more accurate and less expensive. This problem was considered to be acute at least two years ago by the Co-Ordinating Research Council. Whether this problem finds solution in a revolutionary type of combustion apparatus, or some new type of test engine, it will be a difficult and laborious development job.

Impact of Nuclear-Power Development

The impact of nuclear-power development on petroleum-mechanical engineering merits some comment. According to W. Kenneth Davis, Reactor Chief for the Atomic Energy Commission (*Wall Street Journal*, June 30), U. S. scientists are making progress toward economical nuclear power at a surprisingly rapid rate. Present development is directed toward "power-only" reactors as distinguished from "dual-purpose" reactors producing both power and fissionable material to be used for fuel or weapons. It is hard to see how nuclear power could become cheap enough to warrant use in the refinery, in view of the considerable waste fuel available.

There is some possibility that subjecting certain hydrocarbons to nuclear bombardment will cause chemical reactions producing new and useful products. In this case, it is exceedingly doubtful whether the types of reactors now being developed could be applied here.

What petroleum-mechanical engineering really stands to gain is the new knowledge in the field of pressure-vessel design, fluid flow, and heat transfer which is being developed through research in reactor design. Tremendous technical problems of significance for application in petroleum-process design are being solved and can be expected to be reported upon soon. These developments will be watched carefully.

Codes and Standards

Of great importance to the petroleum industry are the codes and standards covering mechanical equipment and methods. The committees in the various technical societies and trade associations which are responsible for the development of these codes and standards and for keeping them up to date number many petroleum-mechanical engineers on their membership rolls. Constant vigilance must be exercised by these oil-industry men to see that such regulations and practices which affect their industry are kept in step with rapid oil-industry advancements. Many times the petroleum-mechanical engineer will need to assume leadership in the work to insure conformance with rapidly advancing practice requirements. The petroleum engineer, ever safety and cost conscious, will insist that intelligent consideration be given to all factors affecting both safety and cost in the development of best practice.

An Optimistic Future

The most optimistic future lies ahead for the mechanical engineer in the petroleum industry. In all his work he will find himself a part of a team of individuals, each having special skills in other and often diverse branches of technology. His part may be as the leader of a project or as a contributor of a small but nonetheless important segment. Close co-operation in all respects will make possible the maximum usefulness of his creative and constructive talents.

Acknowledgment. The author expresses appreciation to Mr. R. J. S. Pigott for his encouragement and suggestions in the preparation of this paper.

A Comprehensive Appraisal of the Profession . . . *A Critical Need*

By S. C. Hollister

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The expanding frontiers of science and industry have created an ever-increasing demand for engineers, at a time when the potential supply of those coming into the profession is shrinking. The only answer can be the reappraisal of the talent available and a pattern of utilization developed which will accomplish the greatest return for society. This is a job which the Council should undertake without delay.

THERE is no doubt that during the past quarter century the tempo of the whole world has increased to an astonishing degree. Through developments in engineering our communications and transportation systems have created the illusion that the world is shrinking so that it is now practically only a fraction of the size it used to be. Because of this tremendous change in communications and transportation the world political arena has been altered completely. Mass attitudes are being built up or broken down.

The Engineer's Role

The engineer is at the core of this development. He has created the technical means which have brought about this change and in many instances has participated in the direction of its development. To an increasing degree he is becoming a practicing sociologist, an active economist, and a political planner, all in addition to his functioning as one who interprets scientific principles into useful works.

While human and international relationships have been shifting at a remarkable rate—a shift in which the engineer's work has been an active ingredient—the very basis of his technical accomplishments, namely, the fund of scientific knowledge, also has been expanded enormously in this period of time. One can only partially dream of the tremendous ramifications of this new knowledge and the extent to which it may be applied to human service.

The public has become aware of the many accomplishments of the engineering profession having a bearing on our daily life—accomplishments that bring men closer together, that unify their problems and common concerns, that lighten their burdens and extend their capacities, and that enhance the common welfare.

Address presented at a meeting of the Engineers' Council for Professional Development, Toronto, Ontario, Canada, October 13, 1955.

Engineers have accomplished so much that now it is taken for granted that what they produce will function without difficulty. It is further taken for granted that they will safeguard the life and property of the public. Nobody stops at the end of a bridge to make computations to see whether or not he should cross the bridge. There is still another public assumption that puts a tremendous responsibility upon the engineer. He has worked so many miracles in the eyes of the public that it is now assumed he will bail mankind out of any crisis that may arise. Take for example our present headlong dash toward consuming our natural resources. If the question is raised that perhaps we should be more cautious we are told at once that when the pinch comes "they" will find something else that probably will be better—"they" in this case meaning the engineer.

Professional Status Recognized. It is easy to see, therefore, that the engineer has assumed in the mind of the community a professional status. As a group, engineers have become a definite entity both as to function and accomplishment in the public mind. This is true regardless of whom the engineer works for or what are the arrangements of his employment.

Demand for Services Increasing. The services engineers are being called upon to render are increasing not uniformly with time but actually exponentially. We know that there are many things on the shelf waiting to be worked upon. We know that new knowledge, useful for the engineer, has been increasing at a tremendous rate. We know also that even with the normal development of former lines of engineering, new avenues of approach are opening in many directions. Thus, not only as time goes on, but also with the increase in population, the services engineers need to render are increasing at a faster and faster rate.

Short Supply of Engineering Talent

There is much evidence to show that only a certain proportion of our population has the necessary qualifications to undertake the engineering profession. Many of those qualifications are similar to those required for success in other lines. Out of a given age group, that is, for example, out of the number of boys reaching age 18 in a given year, only about 17 per cent have the necessary intellectual capacity to undertake work in our profession. This same 17 per cent, however, must also supply the talent for other professions, as law, medicine, science. They must also supply the top-level people in the crafts, including the better chefs, cabinetmakers, glass blowers, toolmakers, and the like. The interplay of interests, the degree of enterprise or of fortitude, will have a bearing upon which field the boy enters.

Several years ago I pointed out that only about 47,000,

amounting to one fourth of the 17 per cent mentioned, could be expected to enter the engineering profession at the freshman level. We have, through the beating of drums and the shaking of bushes, gone higher than this number. A study of performance in college, however, points out that it is quite apparent that after we passed approximately 47,000 the mortality rate took a sharp increase. In other words, it would seem we are dipping a little further into the supply and reaching a little below the likely level of capacities.

Attracting Youth to Engineering. In speaking of this matter of intelligence, the capacity for receiving a certain kind of education, and the like, it must be borne in mind that we are doing so in the light of our educational methods, our guidance systems, and the manner in which we communicate to the oncoming youth the possibilities and attractiveness of the various professions and other occupations which conceivably he might be capable of entering. We need to make improvement in all of these methods of communicating with the youth and we need improvement all along the line in educational operation. These, however, are not going to be changed suddenly. It will be a long process of evolution if we are to make any changes at all, but we must continually try.

Utilizing Engineers to Better Advantage

Returning now to the meaning of our experience of the success and failure of boys attracted to the engineering profession, it is apparent that we have reached a fixed percentage of the population that will enter engineering. When we look again at the services that engineers are being called upon to perform and the fact that these service needs are increasing at an accelerating rate, we see that the demand for services is outrunning the rate of supply of people to perform them. This does not necessarily mean that we have to go without such services, at least not for the present. It does mean, however, that the pattern of utilization of engineers must be modified considerably. We know that in many fields the beginning engineer soon progresses to paper work and from there to administrative duties and frequently to less and less engineering contribution. The pattern of advancement is often in lines other than engineering. It is necessary to modify this state of affairs so that the path and the rewards lie closer to engineering practice.

In this respect we can take a leaf out of the book of the medical profession where the number of doctors is about half the number of engineers in the population. Any doctor performs as the nucleus of a group of competent but less trained people and in such a way the ability of the doctor is proliferated over a wider contact area. To some degree the legal profession is organized along similar lines. The engineering profession, if it is to render the services that we know are ahead of it, must be considerably overhauled both in the manner of utilization and in the pattern of preparation for such a career.

Re-Evaluation Needed

There are already signs of threats to the profession that should motivate us to give heed soon to a re-evaluation of our professional activities. On the one hand, scientists are entering the field, in many cases with telling effect. They have better fundamental training and for the most part they are able to stay in the professional field without shift to administrative function. At the other end of professional activity we are feeling the effects of unionization in areas where large numbers of young engineers may be used in more or less standardized and routine functions. We have become, in part of the profession at least, slaves to job classification rather than men working toward the utilization of individual talents in their highest form.

We in the engineering profession must recognize the fact that there are oncoming problems which it is certain we will be called upon to solve. The situation requires a careful estimate of the new frontiers in science and technology and the point at which we must approach them. Some of these frontiers are in urgent need of development and will render great benefit to the community. The need for developing many of them stems from the fact that some of our material resources are being exhausted and many others threaten short supply. The study is necessarily pointed toward improvement in our essential manpower. Patterns of utilization must be evolved. In short, we need objectives defined in terms of the responsibility the community has placed upon us.

In the foregoing I have given my impressions of the situation in the profession. Most of them are qualitative. Many of them are in some degree controversial. What is lacking in this critical situation is an accurate, carefully made appraisal of both utilization and supply.

Survey to Start at School Level. Suppose, for example, we had a scientific sampling of each school of engineering and we followed the progress of each graduate in the sample. If we did this for different classes of graduates we would amass a body of material that would give us a consolidated picture of the training, development, growth, utilization, and accomplishment of the individuals of the profession. We would then be able to note with some assurance the factors to which we could most profitably give attention.

It is clear, or so it seems to me, that the profession is badly in need of a comprehensive survey having as its objective the evaluation and appraisal of its present and likely future adequacy and an appraisal of the areas in which action must be taken to effect indicated improvements.

ASEE Report on Preparation of Engineers. In 1952 this Council asked for an appraisal of the preparation of engineers, and referred the matter to the American Society for Engineering Education. That society has completed such a study and during the current year has published its report. It is a useful and important study and if implemented, will, I am sure, contribute to the progress of the profession. But at the same time, one is impressed with the fact that it deals with but one facet of a very much larger problem, a problem that the educators may see but can do nothing about.

Study of Medical Profession. A notable study was made of the medical profession about 40 years ago which culminated in the famous Flexner Report. This report

has had a profound effect upon the development of the medical profession and has strengthened the effectiveness of that profession in its services to the community. In consequence it has contributed greatly to the stature of the medical profession in the eyes of the community.

More recently, a similar study has been undertaken in the legal profession. It is too early to mark the results but undoubtedly similar benefits will derive from it.

Benefits From Survey. It would seem clear that everybody stands to gain by a well-executed study of this sort. First of all, the community would be served by any improvement that could be brought about in the functioning of our important profession. Those immediately concerned with function, namely, the employers of engineers and the engineers themselves, would profit both individually and collectively by such a well-designed and well-executed survey. And finally, such a survey should lay the groundwork for improvement and better definition of the engineering profession as a whole.

Who should sponsor such an undertaking as this? It has been suggested that each of the professional branches should undertake a study on its own. One only needs to recall the interweaving of the services of the separate branches, the extent to which they have a relatively common background, the fact that in many cases their talents and efforts impinge upon the same general problem, and the fact that many, trained in one branch, actually serve through their professional lives in another branch, to realize that there would be duplication, waste of effort, waste of money, and, in general, unnecessary confusion if the study were to be made in that manner. Furthermore, it seems to me that such a study needs background that can be obtained only through the guidance of an organization whose principal objective is the development of the engineering profession in all aspects. Clearly then, the sponsor for such an operation should be the Engineers' Council for Professional Development.

A Job for ECPD

What is needed to accomplish such a survey? It would seem appropriate to set up an advisory board from the engineering profession to give guidance to the inquiry itself. This board should represent the various branches of engineering. It should represent different elements of the structure of the profession and different ways in which these elements function. It should be as small and compact as possible. It should report to this Council.

Organized Staff Needed. Under such a board should be organized a competent full-time staff to conduct the survey. It should be headed by a full-time director. It should be staffed with specialists appropriate to the different lines of inquiry.

It would be essential that the operation be adequately financed since it is conceivable that the cost of such a survey would in the end amount to as much as a million dollars. There seems no question, however, that the benefits to be derived by the community are so great that such a sum becomes unimportant in proportion to the benefits.

A Responsibility to Society. As I view our profession and with quiet pride appraise its accomplishments, I feel at the same time a sense of the heavy responsibility that is placed upon us to discharge the enormous volume and range of function that we face. As I look ahead it seems to me that this range and volume grows to staggering proportions and must develop within us all a great sense of urgency to perfect the structure of our profession so that it may continue in its great tradition. I see no greater service that this Council can perform, either to the profession or to the community, than to bring into being such an organization, designed for the appraisal and for the guidance and further development of our profession. I believe that both for the profession and for the community we have arrived at a stage where time is now of the essence.

Mechanical-Engineering Progress in the Petroleum Industry

(*Continued from page 1046*)

supplying materials, equipment, and services to the petroleum industry have kept pace in developing new and better equipment and processes to meet the requirements of the industry. Larger equipment, better drilling muds, improved operating practices, higher-strength materials such as casing, and new services such as electrical and radioactive logging are typical of the developments which have made drilling of a 20,000-ft deep well possible. Hydraulic fracturing, in situ combustion, new completion methods, and improved reservoir operating practices such as pressure maintenance, are representative developments which contribute to more efficient reservoir operation, conservation of petroleum reserves, increased recovery of petroleum, and increased profit. Many wells are now being successfully completed which, only a few years ago, would have either not been recognized as oil wells, or plugged as unproductive wells.

Accomplishments of the pipe-line companies in solving the engineering, design, construction, and operating problems of large-diameter lines have made possible the economical transportation of oil products, and gas through long distances. This has made available gas which was either wasted or unused, to areas which did not have the advantages of this fuel. New process developments, new equipment developments, new materials, automatic controls, and new operating practices have resulted in increased gasoline yields in refineries. They also have made possible development of the fast-growing petrochemical industry.

The recognition of the contribution which technology can make was early recognized by the management of the petroleum industry. The industry has utilized the technical personnel in all phases of its activities for design, research, development, and operations. Progress has made it possible to increase petroleum reserves in the face of increased utilization. New processes, new equipment, and new methods have made it possible to furnish improved products at lower cost and to supply new products to meet the demands.

Acknowledgment

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Forum on Hydraulics[1]

- *Turbomachinery Compressor*
- *Hydraulic Prime Movers*
- *Water Hammer*
- *Centrifugal Pumps*
- *Cavitation*

Basic Problems Center on Fluid Mechanics[2]

THE objectives of the Hydraulic Division are to promote the art and science of mechanical-engineering hydraulics in its various ramifications. Quoting from the Division's By-Laws:

"The interest of the Hydraulic Division embraces the broad field of fluid mechanics, including, but not limited to, the phenomena and natural laws of fluids; the exchange of energy between fluids and machines; the motion of fluids in closed conduits; the effects of the physical properties of fluids such as viscosity, density, and compressibility upon flow characteristics, cavitation action and damage, water hammer and surge. The term 'fluid,' as used herein, includes both liquids and compressible fluids. Of particular interest are the design and performance of machines and structures used in fluid flow, pumping, power, surge control, cavitation, and transmission of power by fluid means."

Initially, the activities of the Division grew out of the special interests of the hydraulic-turbine engineers. Today, more than a quarter of a century later, the very general nature of many hydraulic problems and the importance of other areas of application as well are expressed in terms of activity on a variety of fronts as sponsored by technical subcommittees on Hydraulic Prime Movers, Pumping Machinery, Water Hammer, Cavitation, and Compressors. These are the specific areas in which our subcommittees have been operating for the past few years. Each of these is specific in its interests, yet, throughout the entire group, broad-interest problems of across-the-board application are present. Over the years the programs sponsored by the Hydraulic Division have carried papers in this latter category. Recently, however, the recognition of this across-the-board importance of basic problems has been formalized by the establishment of a new Subcommittee on Fluid Mechanics. In addition, a subcommittee on Fluid Power Systems has been established in response to the increasing interest and importance of fluid power transmissions and controls. The work of this group will be devoted to the technology of fluid power systems and is hoped to supplement and tie in with activities of other divisions of the Society having an overlapping interest in this area.

The Forum had the purpose of considering the status of currently important problems in areas of interest to the Hydraulic Division, and predicting problems most likely to occupy our attention some years hence. As an introduction to this forum, five papers were prepared by already organized subcommittees. While these appraisals are necessarily specific, it was intended that they also might provide the basis for examining the status of problems of more general application.

The Turbomachinery Compressor[3]

A DEVICE can be said to be understood completely when, given the performance requirements, it can be designed in all details so as to meet the requirements to the desired precision (two decimal places are at present sufficient for compressor applications) or, given a set of drawings, the performance can be predicted to the required precision. The turbocompressor cannot yet be said to be completely understood.

Of course complex engineering devices are seldom

[1] Based on five papers contributed by the Hydraulic Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., Nov. 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] An introduction by James W. Daily, Chairman, Hydraulic Division Executive Committee; Professor of Hydraulics, Massachusetts Institute of Technology, Cambridge, Mass. Mem. ASME.

[3] By Howard W. Emmons, Gordon McKay Professor of Engineering Science, Harvard University, Cambridge, Mass. Mem. ASME.

completely understood but the engineer proceeds with their applications anyway. And so it is with the gas compressor. Thus many papers of the past have described and many papers of the future will describe successes (or failures) with old or new applications. To say more would require a prediction of the detailed nature of future applications and thus involve the use of a crystal ball which I do not possess.

The desire to attain a complete understanding of any complex device gives rise to another type of technical paper—those dealing with the fundamental internal phenomena which make up and control the performance characteristics. In this field prediction is somewhat easier and in the case of turbomachinery we are living in an era during which our fundamental knowledge is growing rapidly. Thus it is not only safe to predict an increasing proportion of papers dealing with fundamental flow and strength details but it is even safe to suggest the nature of the content of some of these papers.

Strength Problems

For most compressor applications the strength problem is one of vibrations; vibrations induced in blades, vanes, or disks by coupling through the drive shaft with sources of excitation, or by coupling with the fluid being compressed. Vibrations excited by mechanical means will always be with us and will give rise to an occasional paper as some new application introduces some surprise coupling. Vibrations produced by coupling with the gas will be the subject of considerably more work during the next ten years. The applicability of the "wing flutter" of airplanes to compressor blades is not settled. The blade-to-blade and row-to-row gas coupling is not fully understood. The vibratory effects of the newly discovered propagating stall and its possible cures are as yet relatively unexplored.

Flow Processes

By far the largest number of papers can be expected to deal with the clarification of the flow processes in turbomachines. Long ago the main flow through rotating machinery was elucidated. Thus, starting from nothing but basic principles, a centrifugal or axial-flow compressor can be designed to any performance specification if the precision demanded is not too high. In fact, if our turbocompressor applications were like structures where a "safety factor" of two or so is often acceptable our worries would be over. Consider a gas-turbine application. Some 80 per cent of the turbine power is used to drive the compressor. If the compressor or turbine misses its design performance by more than a few per cent (of flow, say) the expected 20 per cent of useful work may be reduced to zero. Or perhaps the mismatch will cause the starting characteristics to be so bad that the engine won't start. Or worst of all, the compressor may surge so violently that it destroys the engine.

Table 1 Independent Variables in an Axial-Flow Compressor

Type of variable	
Over-all variable	Number of stages
	Speed of rotor
	Diameter and diameter variation
	Hub-tip ratio and its variation
Row variable	Type (impulse row-reaction row)
	Number of blades
	Gap-chord ratio
Interrow variable	Row spacing
	Sealing method
Blade variable	Twist
	Taper
	Stagger
Blade-section variable	Curvature
	Thickness
	Thickness distribution
	Nose radius
	Trailing-edge thickness

Since we are forced to develop compressors to within a couple of per cent of that specified, we are impelled to consider in the design all those phenomena which can affect the performance by this amount. Unfortunately there are many such phenomena and also many geometric variables. Table 1 lists the most important variables affecting the flow which must be selected in an axial-flow compressor. The complexity of the phenomena will provide the subject matter for a host of papers dealing with the nature of compressor flows, and the possible combinations of independent geometric variables will make empirical correlation of experimental results last for many years.

Wide Area to Be Studied

There will be studies, analytical and experimental, on the performance of cascades. The basic problem of flow angles is reasonably well understood only in the simplest case. The reliable prediction of the limits of performance, i.e., stall from the profile, is only partially possible at present by correlations. The nature of secondary flows is currently under active study and can be expected to appear rather frequently in papers during the next five years. Real progress with the flow-separation problem is probably some years away yet. The problem of cascade losses is at present in a most unsatisfactory state, especially in the secondary flow and stall regions of operation.

The additional effects arising in a rotor will be clarified partially during the next decade. Beside the modification to cascade secondary flows and stall flows caused by the warp, twist, and taper of the blades, there are some entirely new effects to be expected from the rotation and the blade-tip leakage. If the compressor is a centrifugal, the interaction of the curved (or radial) bladed portion and the inducer portion is important as well as the interaction of the rotor and diffuser vanes. If the compressor is an axial-flow machine, the interaction of the rows with each other again produces new effects.

In view of the amount of fundamental work now in progress, I would predict that all the basic interactive phenomena (there will be only a few additional ones) will be discovered during the next ten years. Much progress also will be made toward understanding and quantitatively predicting these effects. The quantitative predictions will come largely through the correlation of empirical data but the successful methods of correlation will be suggested by, and the understanding will come largely through, the analytical and experimental study of simplified flow systems.

The Axial-Flow Compressor

Finally, I would venture to predict that in the imme-

diate future the axial-flow compressor will be almost the exclusive objective of fundamental studies but that toward the end of the next decade the application of the new knowledge to centrifugals will again appear.

The new knowledge cannot be expected to do very much for the increase of peak performance. Only small gains can be anticipated. However, considerable increase of performance can be expected during off-design operation. The increased knowledge will permit the conscious design trade-off of peak performance, performance range, stall nature, stall severity, low-speed or overload performance, and other detailed features of the compressor characteristics.

No doubt there is much room for disagreement on the foregoing predictions and only the future can resolve them. Hence this article will warrant rereading in 1965.

Hydraulic Prime Movers[4]

In a paper presented before the American Society of Civil Engineers Centennial Convention in 1952, entitled, "Evolution of the Modern Hydroelectric Power Plant," the author described various engineering achievements which have taken place during the past 50 years in the hydraulic prime-mover field leading to the present very efficient reaction, adjustable and fixed-blade propellers and impulse-type turbines. In the concluding paragraph it was stated, "hydro plants have by no means reached a state of perfection, and continuing technical progress and research will bring further new ideas." Some predictions were made regarding future trends in hydro-plant development to keep pace with the unprecedented load demands and advances made in the design of thermal power plants. The importance of simplification of design and elimination of nonessential structures and parts was stressed as a means of reducing investment and expense to meet rising costs of materials and labor.

Hydro Plants of the Future

It is anticipated that in the future power-development program hydro plants will continue to play an important role in co-ordinated development and that higher-voltage transmission and greater areas of distribution will create new operating requirements and the development of the more remote sites. The advent of nuclear power plants as probable component sources undoubtedly will have the effect of utilizing hydro power principally for peak-load capacity. Inasmuch as nuclear power plants will be to a large extent free from the limitations which now apply to thermal plants fueled by coal or gas, it may be anticipated that they will be located closer to the load centers and possibly adjacent to hydro plants where an abundant water supply is available.

Future hydro projects undoubtedly will be larger in size with maximum-capacity units and the more difficult and marginal projects will be undertaken to make full utilization of water resources with development by federal agencies, partnership plans, or private enterprises.

Continued refinement in the design and materials employed in hydraulic turbines is essential and designers and manufacturers have already taken steps to improve their products through research in their hydraulic laboratories and creative engineering. To obtain a more comprehensive viewpoint on trends and improvements now in process, several of the leading turbine manufacturers were requested to present their ideas regarding prospective developments. The responses were very enlightening and contain a remarkable agreement in the design and fabrication necessary to meet utility requirements. The following are some of the developments taking place in the hydraulic-turbine field which will effect over-all economy and operation.

Turbine Developments

1 Reduction in over-all weight of units by use of lighter but stronger metals, welded construction of casings and turbine parts, including fabricated runners.

2 The use of higher rotating speeds to reduce cost of turbine and generator and to result in powerhouse space saving. This will be accomplished by resorting to higher specific speeds in reaction-turbine runner design from present NEMA recommendations of $650/\sqrt{H}$ to possibly $850/\sqrt{H}$. Improved runner designs with larger-size passages and higher water velocities as governed by cavitation limits will permit operation under higher heads. Present European designs have extended reaction turbines to 1500-ft head which at present is in the range of impulse turbines in this country.

3 Development of impulse wheels continues with emphasis on multiple-jet vertical wheels to obtain maximum practical specific speed under higher heads. The vertical setting has the advantage of powerhouse space saving, although double-overhung, horizontal wheels offer more facility for runner maintenance.

4 For propeller-type wheels, the trend is toward their application for higher-head developments (possibly up to 200-ft head) with larger number of blades and higher water velocities. The combination of fixed-blade and adjustable-blade units will be employed where more flexible operation is required by load conditions. Savings in investment and operating costs are thus realized.

5 Turbine settings and draft-tube design are being studied with relation to their effect upon cost of excavation and possible variation in operating requirements.

6 Improved design based on hydrodynamic principles as developed by laboratory research and special materials for cavitation resistance will permit higher load-carrying capacity of units.

7 The increased use of outdoor and semioutdoor stations will encourage the development of otherwise marginal sites.

8 Automatic and remote-control equipment will also further the development of previously considered marginal sites.

9 The increasing popularity of underground power

[4] By A. T. Larned, Consulting Engineer, Ebasco Services, Inc., New York, N. Y.

stations, whether selected for security or convenience, goes "hand-in-hand" with the economies effected by higher specific speeds, since the relatively deeper settings required do not noticeably increase the cost for this type of installation.

10 Pumped storage for peak-load capacity is becoming more and more attractive, as systems and interconnections become larger and larger. The machinery utilized may consist of conventional pumps and turbines, tandem units with a pump and a turbine connected to a motor-generator, or reversible pump turbine-motor generator units. Also, the schemes may vary from pure storage, with or without regeneration, to diversion from one watershed to another, also with or without regeneration. Evaluation of construction costs and equipment performance will indicate the most suitable solution in any particular case.

Opportunities for Improvement World-Wide

It is believed that simplification of design will be obtained by the use of materials and methods which have been proved and can be standardized. The tendency should be for manufacturers to agree on approved sizes of turbines and generators for various water quantities and head ranges. This should lead to improvements and simplifications and to consideration of the turbine and generator as a basic part of the same machine rather than as separate entities custom-made for each location. The omission of sensitive governing devices and surge tanks may be possible where necessary speed regulation can be accomplished by other means in interconnected systems.

A greater liaison is necessary between manufacturer and engineer with respect to the effect of all elements of the turbine design upon the cost of the over-all development. There should also be increased communication of ideas between American and foreign engineers to the end that research and development in all parts of the world will contribute to the benefit of the industry. American technical aid to other countries with the use of equipment built in this country and abroad has already resulted in mutual exchange of ideas.

Hydroelectric power has been an important factor in world economy and undoubtedly will continue as a main source of energy production in many countries and in areas of the United States richly endowed with water resources.

A recent Government survey (USGS Circular 367) on "Developed and Potential Water Power of the United States and Other Countries of the World, December, 1954," indicates that the world water-power potential, based on ordinary minimum flow of streams, is 649 million horsepower, of which the United States possesses 36.5 million horsepower. By regulating streams at reservoir sites where construction is physically feasible it is estimated that this low flow potential could be almost doubled.

The opportunity for creative engineering and improved technique in fabrication of hydraulic prime movers will continue to test the ingenuity and resourcefulness of engineers and manufacturers.

Water Hammer[5]

In this 1955 Diamond Jubilee Forum on Hydraulics we are concerned with the present and the future, but lessons from the past may help guide us in the future. This is particularly true of the phenomena of water hammer where analyses in advance of design and construction can guard against failures in service.

Is there now sufficient knowledge on this subject available? Can the engineer make such advance analyses or must he wait for a service failure to find the weak points in design?

From the Past

Looking backward for a moment—just to see where we have come from—we find several interesting facts:

1 Technical publications on water hammer were practically nonexistent in American engineering literature prior to the year 1900.

2 By contrast there were in Europe, prior to 1900, a number of published papers on the subject, but mostly theoretical in nature. Few were based on test work.

3 In 1897 Joukowsky's classic experiments and development of the elastic-wave theory stimulated the publication of technical treatises throughout Europe. The "Notes" of Allievi in 1903 and 1913, interpretating and amplifying the "elastic-wave theory," has been the foundation of most of our present-day knowledge.

4 While Joukowsky's work was published in the United States in 1904 by the American Water Works Association and Allievi's notes were translated into English by Eugene Halmos in 1925, only piecemeal use seemingly was made of these contributions, except for the work of Gibson published in 1920 by the American Society of Civil Engineers.

5 Since 1931, however, greater interest has been shown and American engineering literature now contains many valuable technical studies on water hammer. Results of field tests, compared with theoretical analyses, have confirmed the validity of the elastic-wave theory.

Where Are We Now?

Current experience shows that the 1933 to 1955 "barrage" of technical articles on water hammer has made available a whole new set of tools with which to solve such problems.

Two books on the subject of water hammer have been published recently, one in 1951, using arithmetic integration procedure, and the other in 1955, stressing graphical procedure. Both analyze involved problems that heretofore seemed impossible of rational solution.

Greater knowledge of the behavior of pipe-line materials, more data on the characteristics of fluids other than water, and a better understanding of the subject

[5] By S. Logan Kerr, Consulting Engineer, Flourtown, Pa.; Chairman, Committee on Water Hammer, ASME; Chairman, Committee on Water Hammer, AWWA. Fellow ASME.

have improved the accuracy of theoretical analyses. The extension of the elastic-wave theory to petroleum pipe lines suggests the use of "surge pressures" instead of "water-hammer pressures."

Prediction of surge pressures in advance of construction or operation is becoming recognized as a sound procedure for curing trouble before it happens. There is a better understanding of why failures of water conduits have occurred when and where they did. The mere "beefing-up" of lines or the use of "standard allowances" for water hammer are no longer considered to be the only solution for safe and economical design.

For the Future

Has water hammer or pressure surge in pipe lines been eliminated as a major problem?

The answer must be both "yes" and "no."

On large projects where cost or safety are paramount factors, engineers are using theoretical analyses to guide design.

On smaller systems, the same attention has not usually been given to the study of surge pressures. The lack of time, the unfamiliarity with theory, the greater factors of safety present in small-diameter pipe, have all contributed to the lack of advance analysis of water-hammer conditions.

The practical designing engineer is wary of the complexity of many of the theoretical presentations, of the mystery surrounding the use of differential equations, and of the lack of confirming test data.

The Immediate Problem. Our immediate problems seem to fall into three groups:

1 To secure a broader understanding among designing engineers of the value of surge analyses. Such studies should not be left exclusively to the mathematical genius. The language of presentation should be simple and direct.

2 To correct popular misconceptions about water hammer as, for example, "no noise, no water hammer"; "short-cut" formulas; "cure-all" devices; "close the check valve the instant the flow stops"; "flow through valves is directly proportional to stroke"; and so on.

3 To build confidence in theoretical surge analyses by making field tests, publishing the results with comparisons between test pressures experienced and those computed in advance.

The Long-Range View. For the long-range problems, there are many things still to do, such as the following:

1 "Blind spots" in our theory exist. For example, the best method of accounting for friction has not yet been found.

2 The surge phenomena during discontinuous flow (parting and rejoining of the water column, for example) can be estimated, but more research and confirming test work is needed.

3 Much more information is needed on the behavior of various types of valves in flow lines, in pump-discharge lines, under throttling conditions, and under free discharge conditions. Since surge pressures are a function of the maximum rate of change of flow and of the initial flow existing before the change takes place, more test data of this type are essential.

4 The complete characteristics of centrifugal pumps have a great effect upon the surge pressures experienced during sudden shutdown. Some excellent papers have been published, but the types of pumps tested throughout their entire range are few and are limited to a relatively narrow band of specific speed.

5 A greater knowledge is needed of the surge characteristics of water-distribution networks. Flow-distribution analyses have become commonplace. Some study on water hammer, both theoretical and applied, is needed to aid in the design of complex systems, particularly when automatic devices or booster pumping stations are used.

6 Critical analyses and testing programs are needed on the performance characteristics of relief valves, surge-control valves, check valves, and regulating devices to establish their range of safe and useful application to water-hammer correction.

7 The use of electronic computing devices for surge analyses has much promise. Such devices offer a means of reducing tedious computations. Their range of accurate application must be evaluated and their limitations established. Careful checking against established methods are needed to give full assurance of reliability.

Surge-Wave Theory a Useful Tool

In conclusion, we have come a long way in the development and application of surge-wave theory for fluid flow in closed conduits.

Much of the theory has been proved sound. However, solutions of surge problems are difficult if the theory is inadequate in its scope. Solutions are dangerous when theory is incorrectly applied. Both these factors must be kept constantly in mind.

Design philosophy must be sound in its conception and in its application. Safety with economy, based upon accurate evaluation of operating conditions established in advance, should be a keynote in our future use of surge theory.

There is no "royal" road or single device that will give the answer to all surge problems. Many cases can be solved easily, but others will still require the specialist to assist in securing the safe and economic design.

Centrifugal Pumps[6]

As our civilization has become increasingly complex and individuals more interdependent one on the other, it has become necessary to move fluids for many purposes at an ever-increasing pace. Many years ago the fluid to be moved was generally water, and nature largely took care of this. Today, nature is no longer adequate—either for the natural-water supplies, disposal of sewage, or for today's intricate problems of chemical and food processing.

Pumping machinery has become the very heart by which the life-giving fluids supply the many limbs of

[6] By Ralph Watson, Associate Dean, L. C. Smith College of Engineering, and Chairman, Department of Mechanical Engineering, Syracuse, N. Y. Mem. ASME.

our industrial civilization. Of the many forms of pumping machinery, none have become more important than the dynamic type of pump, of which the centrifugal pump is typical.

My comments for this panel discussion will be confined largely to this dynamic form of pumping machinery.

Growing Use of Water

Many people around the country have become acutely conscious, through taxes, bond issues, and publicity, of the importance of pumping machinery for water supply. Many are conscious, but probably less so, of the use of pumps for sewage disposal. As the farmer has realized the value of a dependable source of water and particularly in areas which are arid or semiarid, the use of various forms of pumps has become familiar to him. As human centers of population have grown, local water supplies become inadequate, and it has become increasingly necessary to go great distances for additional supplies of water. New York City has reached out for miles around to obtain water for its many millions. The southern part of California, after tapping all local supplies, has reached over to the borders of the state to tap the Colorado River to meet its inadequate supplies.

Individual pumps of enormous power have been built to handle, literally, rivers of water. Pumping equipment of 12,000 hp, 25,000 hp, and up even to 60,000 hp in individual units have been built.

Yes, water supply is one of the major problems facing the world and the United States today. With growth of population and industry, demand for water per person has grown fantastically. With naturally watered areas most suited to farming being cut up for suburban areas or for factories or cities, more arid areas are being used for crops. In addition, as the area farmed decreases in proportion to the population, increased production per acre is essential. For this greater reliability, soil moisture is essential. Nature cannot be depended upon to send rain at just the right frequency and in the correct amount. This is why a redistribution of water from the areas where it is currently in oversupply to the areas where it is needed has in recent years drastically increased our interest in water-supply pumping.

This need has also created an enormous market for deep-well pumps, shallow-well pumps, ditch pumps, and the like. We have gone deeper and deeper to tap underground water reserves.

As the rate of pumping of underground-water supplies increasingly exceeds the natural make-up, it becomes obviously necessary to supplement locally available supplies with water pumped from even more distant sources. It is for this purpose that the enormous projects in the western states have been designed—22,500 hp at the Tracy site in Central California, 3000 to 12,000 hp at the Metropolitan Water District development in Southern California, to the 60,000 hp at the Grand Coulee location in Washington.

In recent years, during a drought period, New York City has found it necessary to tap the Hudson River as an emergency measure.

With the increasingly long lines and sizes involved in water supply, problems of water hammer will be, and are becoming, more and more important. In general, we know how to handle these problems, if they are thought about. However many problems, which in the past were considered negligible and are negligible in small sizes, have become important in the larger sizes, as the vibration at the Grand Coulee installation brought out so clearly and so painfully.

It is believed, however, that we have the main body of essential know-how and experience to design, build, and operate the necessary pumping machinery for water supply, flood control, and sewage required for the anticipated growth of several years in the future.

As our population growth continues, and the home, the farm, and industry increasingly mechanize, our per-capita use of electric power has risen explosively. A steady expansion of electric-power capacity has occurred for many years, doubling, approximately, every ten years.

Effects on Size and Speed of Pumps

To meet this growth and to offset rising costs of labor, materials, and fuel, power companies have steadily increased the size of the equipment involved, simultaneously raising the steam pressures and temperatures generated. The centrifugal boiler feed pump is the heart of the circulating system for the working fluid.

When existing practice, knowledge, and mechanical limitations held the speed to that obtainable with 60-cycle direct-drive motors, feed pumps began to develop into monstrosities and designers' nightmares. To produce the desired pressures of 3000, 4000, 5000 psi and higher, the pumps became enormous, the span and the deflection of the shaft became too high a percentage of the impeller diameter for good efficiency, and the head-capacity characteristic was adversely affected. With the development and acceptance of step-up gear drives due to recent improvements in gear reliability and noise, 3600 rpm as a speed limitation was eliminated. This move was also helped by the fact that in the 1500-hp and up range, a two-pole motor was approximately equal in price to a four or six-pole motor and gear combined. The increased pump speed, with better impeller proportions, increased the obtainable efficiency more than sufficient to offset the gear loss. At the same time, materially reduced pump size and improved shape of the head characteristic have given increased impetus to high pump speeds. The additional degree of freedom to choose a satisfactory and optimum pump speed will be used increasingly in the future.

Pumps for Processing Industries

Ours is an age in which we are building materials to specifications unthought of a few years ago and unheard of in nature, or we are duplicating and bettering nature's own materials at a cost and reliability in supply unobtainable from natural sources. The key to low-cost chemical processing is generally *continuous* processing, and here again the centrifugal pump is usually the means by which the product chemicals are moved from step to step in the change from the raw material to the final product.

Consequently, a great variety of materials and designs are required for pump construction and an almost equal variety of forms. Pumps are made of many different materials, each with a range of chemicals which it can handle with an acceptable rate of corrosion or erosion. Pumps are made of plastic; pumps are made

of carbon. We have glass pumps, ceramic pumps, and others, each of many compositions for specific purposes. Each also has a special construction to avoid breakage from thermal or mechanical shock. Pumps must be designed to handle, without clogging and without damaging the product, solids in suspension, slurries which are often highly abrasive, stringy material, highly viscous material, and materials which will only flow when once started flowing, and at temperature ranges from —200 F or lower to as high as 1200 F. Each material can be handled best by a pump, the shape of which is peculiarly adapted to the specific nature of the fluid handled and to the materials required and suited to the construction. It is not surprising that the basic forms and material combinations with all the variations are numbered in the hundreds of thousands.

In food processing, where minute quantities of corrosion or erosion products would alter the flavor, or in the production of synthetic fibers where traces of foreign material would alter product color, almost complete freedom from corrosion or erosion is essential. For this purpose, very corrosion-resistant and exceedingly expensive materials are used in the pumps and ultimately are the least expensive.

Frequently, because of the hazardous nature or extreme value of the fluid circulated, pumps of completely leakless design have been developed.

Very recently, the literally explosive development of the atom as an energy source has created a demand for centrifugal pumps, of a type considered as prohibitively costly dreams (or should I say nightmares?) a few years ago. Yet today, leakless pumps for almost any ambient pressures are available up to several hundred horsepower. The results are considered to more than compensate for the cost.

Before we leave this sketchy survey of what might be termed the industrial application of pumps—what of the home and consumer uses? A quick check will find fuel-oil pumps in the heating system, sump pumps for cellar drainage, and pumps in the washing machine. In many areas beyond the city water systems, the use of shallow-well pumps for home and barn supply of the reciprocating, centrifugal, or jet types are commonplace, and in very recent years, reliable submersible electric-motor-driven centrifugal pumps have been developed for this purpose. We could validly include the blowers in our wives' vacuum cleaners under the category of centrifugal pumps, handling a very light fluid. A great deal of effort has gone into the improvement in performance of vacuum cleaner "centrifugal pumps," and is continuing.

The Future

Looking to the future, it is clear that community needs for water will continue to grow and require reaching out to distant sources. This automatically means larger units and greater total pumping horsepower. Whether to use a few large pumps or multiple small units operating in series and in parallel will depend on local conditions and the program for developing the sources. However, the natural trend will be toward fewer and larger individual units. As experience teaches us more about the operating and structural-design problems and solutions, large units will be projected more confidently.

In Southern California, with its enormous population growth in a semiarid land and the development of agriculture in the San Joaquin Valley, serious studies are being made of plans to bring water from Northern California, where it is currently in oversupply, hundreds of miles to the deficient southern portion of the state.

On a national basis, as several communities in an area use up local supplies and reach out for the same water sources, the need to draw on distant sources and develop interlocking lines of supply will face us abruptly. The problems this will introduce will be similar to those faced by the electric utilities as power lines lengthened and systems were interconnected. Problems of system vibration resulting from fluctuations induced by the supply pumps and by the users will become too complicated for analysis by normal calculation. Fortunately, the network analyzers now being used by the utilities with increasing frequency offer equal value for the analysis of the future water systems.

When the areas of primary fresh-water supply, economically available, are used, there remain two sources not presently used to any great extent. The first is the intentional and planned use of treated sewage and the second is the sea. The first, if normal revulsion to the idea could be overcome, immediately would triple the available water for the water-short areas. In the modern complete sewage plant, the effluent is equal to, or better than, that obtained from many water-treatment systems. Along some large rivers, the drinking water of one city is obtained from the diluted, untreated, or partially treated sewage discharge from one or more cities upstream.

Whatever the water source, the movement of the water, corrosive, viscous, salt-laden, and abrasive, will be handled by centrifugal pumps through the treatment plants into the distribution systems, to be pumped again as sewage from low-lying areas to and through the sewage-treatment plant to the final discharge. Natural drainage is rapidly becoming undependable and unsatisfactory as a means of collection and discharge of sewage, hence pumped flow of sewage will increase even faster than the growth of water and water supply.

The ever-increasing pressures encountered in power plants have been mentioned. This will be met in the future with pump speeds of 10,000 rpm or higher. With the higher water velocity, corresponding to the higher speeds and fewer stages, and the increased purity of water, erosion of the surfaces is to be expected at some critical combination of velocity, operating sequence, water purity, temperature, surface shape, and material. This critical combination will produce an erosion rate vastly more rapid than below this critical combination and will be somewhat similar to the problems which developed with low and medium-pressure boiler feed pumps a few years ago. The upper limits at which these problems will be met have not been established.

Problem of Cavitation

The natural tendency in our industrial economy is to use the results of our labor, in this case pumps, to produce more from the same or less manufacturing effort. With this comes problems which are either intensified or were not important before.

The requirements to avoid cavitation in centrifugal pumps are not understood widely by all users, or even

by all manufacturers, to this day. With existing speeds, small local cavitation has been accepted often as a necessary evil. However, we can expect local cavitation in the impeller to be an increasingly important factor as speeds increase. The small pressure fluctuations resulting from unstable inlet conditions or from the presence of a finite number of vanes in the impeller and the casing, while generally unimportant, can be expected increasingly to produce line vibrations as the relative rigidity of the discharge of lines decreases with size and length.

As speeds increase, we can expect increasing attention to be given to the possibility of side-wall bulging under cavitating conditions. Some impeller side-wall bulging has been encountered in the past with condensate pumps in which the rate of pumping was controlled by cavitation on the inlet side. While this was, in each case, corrected by a redesign of the impeller, we can expect an increasing problem to develop from this source in the future.

Problem of Higher Pressures

Higher-pressure rise within the impeller will reach a point where castability and machinability and centrifugal stress, as the only concern, will have added stresses resulting from the differential pressure across the vane and across the impeller side walls. With this increase in head, increasing attention will also have to be given to the problem of radial reaction and to the problem of local erosion of the casing and impeller discharge tips, resulting from operation at off-design conditions. This may reduce to a considerable degree the breadth of departure of permissible operating conditions from the normal-design flow rate. Laboratory experience first and subsequently field experience will give the only answers to these questions.

Other Problems to Be Solved

With direct hydraulic problems comes a host of material problems not only for the casing and impeller but also for wearing rings, bearings, stuffing boxes, and the like. A great deal of data on this type of problem is currently being obtained by many companies. That which has been released from security considerations is generally available in the literature. A great deal is still under security wraps or under company limitations as "private know-how."

There are several problems on which more exact knowledge is needed, problems which will become increasingly acute in the future. The need for better information on the effect of velocity on the erosion rate of materials has been mentioned. This is particularly important as pumping machinery is used for applications where the life is measured in minutes, as in rockets, to applications where it is measured in months, as in many chemical processing industries, to applications where life is measured in years as in the utilities.

More experimental knowledge on all of the factors which control the shape of the head-capacity curve must be obtained. Because performance at conditions away from the maximum efficiency involves, to an important degree, unstable flows in the approach to the pump, in the impeller, and in the casing, small deviations can cause a marked difference in performance on two ostensibly identical pumps.

As the variety of fluids pumped, materials used in construction, and temperatures involved increase, and as the importance that maximum assurance of predicted life is to be achieved grows, influencing factors of rate of cavitation-bubble collapse, bubble size in relation to the model size on the local dynamics of cavitation-erosion will require additional attention. With the extreme importance of guaranteed predicted life which results from the need to seal a system, as in the handling of coolants and radioactive materials in nuclear reactors, additional knowledge must be obtained.

Little has been said about various forms of positive-displacement pumping machinery; this omission is intentional as this is a subject in itself. However, with the better knowledge of dynamics of fluids and mechanical motions, and with the increasing demand for high pressures and high efficiencies, the potential value of this long-neglected type of pumping machinery must not be overlooked. When one contemplates the great increases in pressures handled and the importance of efficiency over a wide range of operating conditions for some applications, an increased study effort on positive-displacement machinery is clearly warranted.

As in many industrial uses of equipment, the detailed knowledge needed for precise design falls short of the requests and actual usage of the equipment. A considerable amount of design is the result of extrapolation—and hope. Possibly this symposium will stimulate experimentation to have available all the information required before the equipment is designed and built.

Cavitation[7]

CAVITATION is a relatively new field in hydraulic engineering. Its newness is rational because, with rare exceptions, it is a phenomenon that becomes critical only in high-velocity flow, and high velocity is a modern development. The word "cavitation" was coined at the turn of the century. Since it was first recognized, cavitation has been troublesome to designers and users of hydraulic equipment. Consequently, it has always been a field for active investigation.

Studies Follow Traditional Pattern

Developments in cavitation have followed the traditional pattern traced by most physical phenomena after their existence is first recognized. In their original manifestation they are apt to appear deceivingly simple. Then, as they are investigated further, more contradictory characteristics come to light and the subject be-

[7] By Robert T. Knapp, Professor of Hydraulic Engineering, California Institute of Technology, Pasadena, Calif.; Chairman, Cavitation Committee. Life Member ASME.

comes more and more confused. Maximum confusion usually takes place just before some worker finally catches a glimpse of the basic nature of the phenomenon. With this new understanding as a guide, the various bits of contradictory information begin to fit together into a whole. It is then usually possible to make important advances in practical applications in the field. With many phenomena, this cycle may be repeated several times before a truly satisfactory state of knowledge is reached.

During the past decade or two, the cavitation field has been passing through the first phase of a second major cycle. Two classes of activities have occurred: (1) Obtaining more and more empirical information about the detailed characteristics of the more important cavitation effects and learning how to avoid or circumvent them in the design and operation of hydraulic equipment; (2) exploring both experimentally and analytically the basic nature of the phenomenon.

Empirical Information

In exploring the effects of cavitation on performance characteristics, it has been found that hydraulic equipment may be operated satisfactorily under cavitating conditions provided that the amount of cavitation is not excessive. However, when the amount reaches a certain critical value, the performance breaks down very rapidly. By recognizing that the presence of localized cavitation indicates the existence of a corresponding low-pressure region, the designers have been able to improve the shape of critical passages to obtain satisfactory performance at ever-increasing speeds and heads. Laboratory methods of determining tolerable degrees of cavitation (such as the use of Thoma sigma curves) have been developed to give the designer more certainty.

Much effort has been expended in investigating the damage effects of cavitation. It has become clear that a degree of cavitation which is insufficient to affect the operating characteristics seriously is often sufficient to produce appreciable damage. Thus a great deal of work has been done to develop satisfactory methods of damage repair.

It has been found possible to replace a damaged material by inlaying or welding on new material, usually of a more cavitation-resistant nature. In this connection, careful evaluation of the damage-resistant properties of the available materials shows that there is a wide variation between that of the usual construction materials and some of the metals used for repair. In particular, the work-hardening stainless steels have been found to have enough resistance to reduce cavitation damage to acceptable rates.

Out of this growth of knowledge has come a new practice of applying the damage-resistant material in critical areas during original fabrication of the equipment. This has made practical the use of higher speeds and higher settings, with a consequent decrease in the first cost of the installation.

Nature of the Phenomenon

During recent years considerable progress has been made in exploring the nature of the cavitation phenomenon. The mechanics of the process have been explored by several methods, including the direct one of high-speed motion pictures. It develops that cavitation can vary both in degree and intensity, and the effects of such variations may be quite different. For example, varying the degree may vary the performance characteristics but have little effect on the damage rate, whereas varying the intensity may vary only the damage. The physical characteristics of the liquid have proved to be very important. Such properties as density, compressibility, surface tension, wettability, viscosity, belong in this category. The fact that liquids inherently have surprisingly high tensile strengths has become recognized, together with the implication that cavity formation requires weak spots within the liquid. This has given rise to the concept of nuclei, the properties or even actual existence of which have not yet been demonstrated conclusively. Since damage is such an important cavitation effect, it has been given a large amount of study. Important steps have been made in determining the physical nature of the attack by the liquid on the guiding surface, which give promise of shedding more light on the variations in the reactions of the different solid materials to this attack.

Cavitation Committee

The Cavitation Committee has been trying to play an active part in this program by (*a*) offering a convenient medium for exchange of technical knowledge between workers; (*b*) assisting, wherever possible, in the integration and evaluation of new knowledge; (*c*) attempting to stimulate work in critical or neglected areas. The tools that are used are: Discussion in the Committee meetings or by correspondence, holding open meetings for informal discussion of points of current interest, organizing technical sessions for the Society meetings.

This year the Committee has embarked on a new venture—a three-day seminar just prior to the Annual Meeting, for discussion, in considerable technical detail, of one special phase of the field. If the membership of the Society finds this type of activity worth while, it will probably be continued in the future to include other currently important aspects.

Future

It is usually interesting, but never very safe, to make predictions about the future. It appears that the field of cavitation is in a transition period from an art to a science. It is felt probable that in the technical sessions, committee meetings, and the seminars to be sponsored in the future by the Cavitation Committee, topics like the following will be presented for discussion: (*a*) The deliberate use of cavitation for performance control of special equipment; (*b*) the development of satisfactory designs for normal operation with major cavitation; (*c*) methods of measuring cavitation intensity; (*d*) correlation of intensity with damage potential together with reliable ways of predicting these quantities for specific field conditions; (*e*) increasing standardization of tests of damage resistance of materials, and correlation of such measurements with intensity of cavitation or damage potential for the reliable prediction of damage rates for specific installations; (*f*) correlation of laboratory and field testing and the determination of scale effects for loss in performance, damage, vibration, and other major manifestations of cavitation; (*g*) advances in the formulation of more adequate theories of the cavitation process and of cavitation damage.

Analysis of Development Trends . . . . . . in Industrial Diesel-Power Units

Improving the diesel-engine's cyclic performance and broadening the range of usable fuels can contribute greatly to an improved market acceptability of industrial-type diesel engines

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IN THE modern diesel engine one can observe significant answers to problems of the past. By a review of the past and its developments one can often evaluate future trends and find aids to predict the shape of things to come.

A development emerging from the Ackroyd experiments is the surface-ignition engine of the type designed by Bolinder in Sweden in 1913. Fig. 1 illustrates a Bolinder loop-scavenged two-cycle design operating with a low compression pressure of 225 psi. The scavenge air was furnished from the underside of the piston so the bmep was relatively low—about 28 psi. The aid of a torch was required for starting and for continued idling. A jet of fuel from a pump at about 100 psi injection pressure spread a film of black oil over the inner surface of the uncooled cast-steel cylinder head. This cylinder head was given its initial heating by a blow torch, after which a suitable running temperature was maintained by virtue of the continuing combustion periods, modulated from time to time with water injection.

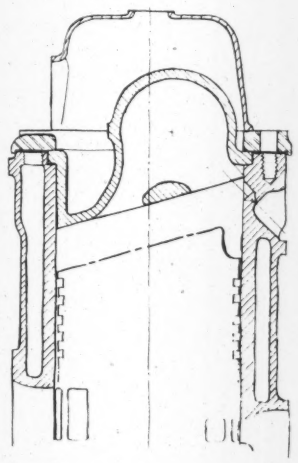

Fig. 1 Bolinder engine of 1913 design

The fuel-injection period took place relatively early in the compression stroke thus exposing the fuel to compression temperatures for periods sufficient to cause a film of vapor to rise above the liquid surface, and ultimately ignition is achieved in the vapor phase. Usually combustion was such that extremely rapid rates of pressure rise occurred within the cylinder. However, when combustion was nurtured properly by the skilled manipulation of the operator, smooth operation could result. This, however, was accomplished only as a result of the combined synchronous effort of the operator in tune with the engine controls.

With the passage of time improvements were made which formalized the design into higher compression ratios, higher injection pressures, and smaller uncooled surface areas.

The MAN "Whisper" Engine

These trends have crystallized into the type of design recently developed by MAN, as shown in Fig. 2. Here

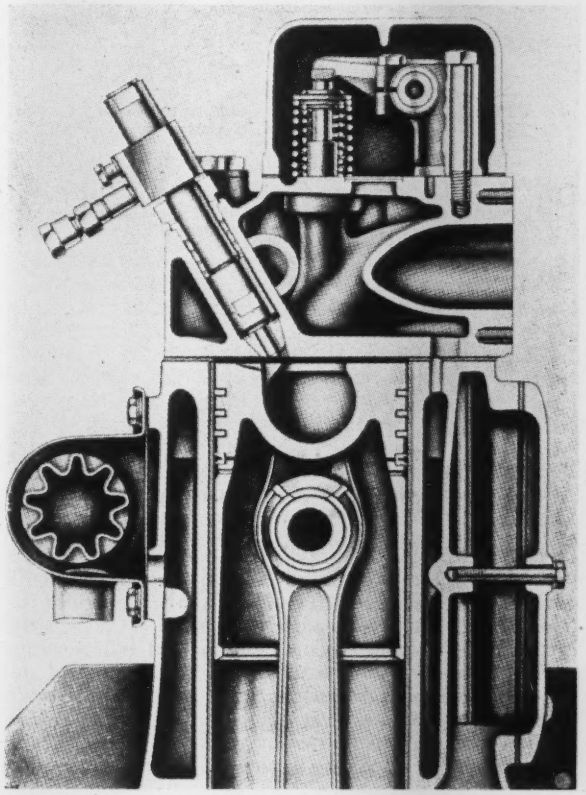

Fig. 2 MAN Whisper engine with surface ignition controlled to a point that produces smoothness of operation, high performance, and satisfactory torque characteristics

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in the Whisper engine we have surface ignition controlled to its desired nicety in producing smoothness of operation, high performance, and very satisfactory torque characteristics. A description of its operation has been given by Prof. Paul Schweitzer (1)[1] as follows:

"The MAN combustion system is an open chamber engine fitted with a masked inlet valve and the piston is permitted to create considerable squish at the end of the compression stroke. The combustion process is then as follows: As the piston approaches top center on the compression stroke, a vigorous air swirl sweeps the piston

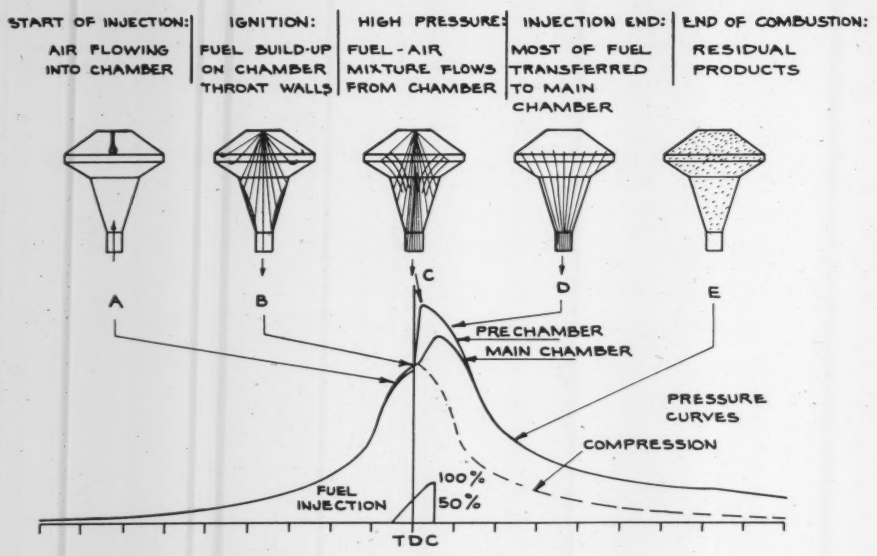

Fig. 4 Diagram portraying the precombustion-chamber engine combustion sequence

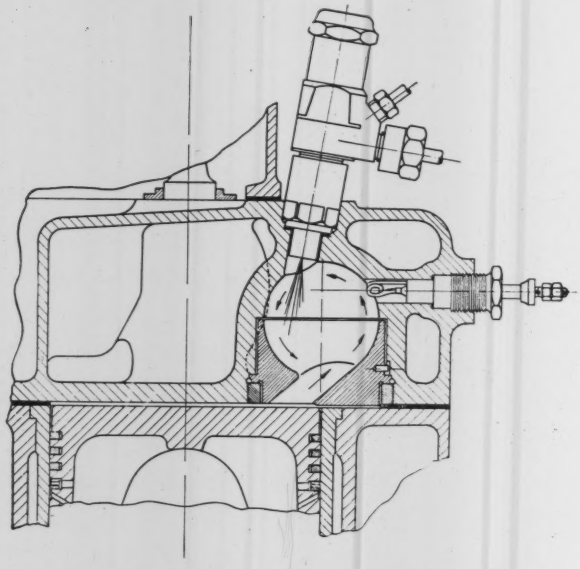

Fig. 3 Section of Ricardo Comet combustion chamber

cavity. Two jets penetrate into this and they form a little cloud before they strike the hot surface of the piston which is held between 400 to 750 F by the control of the lubricating oil sprayed under it. This cloud acts as the initiator of ignition much as the fuel-oil fraction in a dual-fuel engine. In the meantime the balance of the fuel is smeared on the semispherical combustion-chamber wall and becomes vaporized at a controlled rate. As the fuel is vaporized it is ignited by the flame and burns in a narrow layer near the wall, then more fuel strikes the wall and the burning continues. The flame front never has a chance to develop and a large amount of fuel never has a chance to crack at any one time."

This engine improves on the old surface-ignition type of combustion which was used 35 to 40 years ago. In the MAN engine we have the application of new combustion knowledge superseding old ignorance and achieving, by application of advanced concepts, what has been conceded to be a rather revolutionary type of combustion system. Many other old ideas are due for new overhaul before the diesel becomes extinct. It is interesting to note how many of the features that were in the original Bolinder concept have now achieved a satisfactory answer in a practical performing engine.

The Ricardo "Comet" System

It has been reported in some recent combustion photographs of the Ricardo Comet system, Fig. 3, that ignition appears to take place directly from the projecting edge of the throat in the swirl chamber isolated cup. This insulated member is employed as a regenerator and serves a useful purpose by transferring heat to the fuel in its immediate vicinity.

In the precombustion-chamber engine the heat-isolated throat serves as a surface-ignition device in causing vapors to rise from the cone of the venturi. The vapors are ignited and the resulting gas velocities provide the energy to eject the main body of the fuel from the precombustion chamber. This is indicated in Fig. 4, diagram B.

The trends revealed by surface-ignition studies through the years indicate its significance as a factor in industrial diesel-engine designs and point to the need for continued research on its influence on the combustion process. Certainly the results achieved in improved performance with quiet operation by the adaptation of these principles should promote continued effort in exploring still uncovered virtues.

Fuel-Injection Methods

In the diesel engine the combustion process is largely influenced by the means by which mixture formation is

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

achieved. In the early diesel experiments mixture formation was found difficult to achieve when using mechanical injection of fuel. The problem of atomization was solved by utilizing the air-injection principle.

These particles of oil were carried on a vehicle, the injection air itself, with sufficient energy to be dispersed into the combustion chamber.

With the development of better injection methods sufficient energy now can be imparted directly to fuel particles without the aid of an air vehicle. These fuel particles become atomized by virtue of the factors of (*a*) the velocity of the jet, (*b*) the friction drag at the interface between the jet and the air, (*c*) the density of the air of compression, and (*d*) the surface tension of the fuel. The mixture of fuel vapor and air occurs as a result of vaporizing drops moving relative to the air and as a result of the turbulence in the combustion chamber.

Gas-Injection Principle. The air-injection principle impressed itself and was a factor in the development of the precombustion chamber. The precombustion-chamber process (2) embraces principles which prevail in both mechanical-injection and air-injection engines. This method can be termed the gas-injection principle. The method of fuel metering and the injection of fuel through suitable orifices at correct timing and at modulated injection rates are common to both systems. The combustion of a portion of the injected fuel in the precombustion chamber not only shatters the major portion of the remaining fuel charge, in a manner analogous to that of the Claudell carburetor system, but also furnishes a highly energized vehicle for transporting the resultant combustible mixture into the main combustion chamber. Here the mixture is distributed thoroughly by permeating the available oxygen at extremely rapid rates, the distribution thus approximating to air-injection functioning.

Dynamics of Combustion. Fig. 4 portrays the dynamics of combustion. Here for the sake of simplification the pressure cards are idealized. At A, fuel injection into the precombustion chamber starts, and at point B approximately one half the fuel is injected under full-load operating conditions. At this point also the fuel ignites. Fuel injected before ignition will be distributed in the air of the precombustion chamber and some of it deposited on the throat walls of the chamber. The throat, therefore, acts as a collector for the heavy fuel spray during the early stages of injection. Later this fuel is scrubbed off and dispersed by the high-velocity gas mixtures resulting from the combustion in the precombustion chamber. After flow has been established from the precombustion chamber through the throat area, the remainder of the fuel is shredded off the conical surface and passes out with a high-velocity gas stream into the main combustion chamber.

The construction of the precombustion chamber is such that the highly atomized fuel is forced into a region where ignition takes place. The ignition of the fuel in the burner-tube portion of the precombustion chamber establishes a high pressure within the chamber. High-speed schlieren photography has indicated that the velocity of the issuing stream from the burner-tube is initially 500 to 750 fps, depending on the injection characteristics and timing. Peak velocities may be as high as 1000 to 1200 fps when the pressure difference reaches 200 psi. This situation is illustrated at C in Fig. 4.

Combustion Analysis. In the analysis of combustion the characteristics developed in Fig. 5 can prove of value and

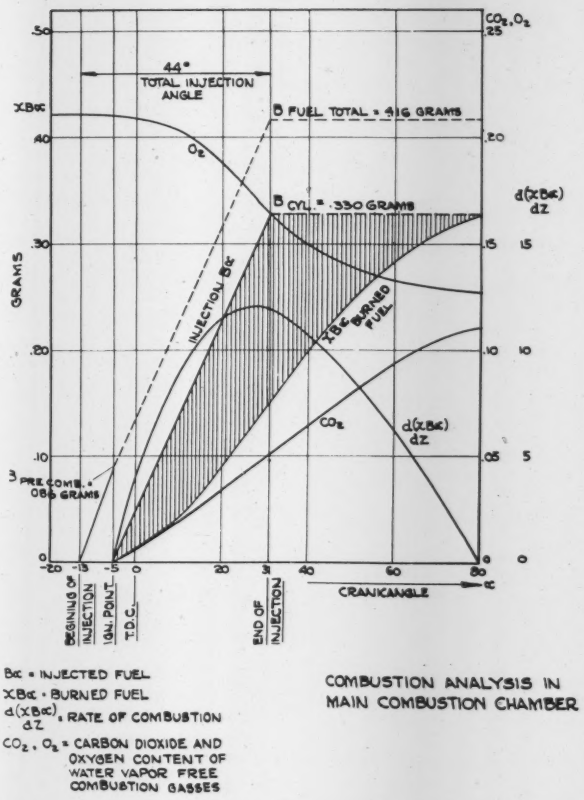

Fig. 5 Combustion analysis in the main chamber of precombustion-chamber engine

interest. These were made for a precombustion-chamber engine of about 600 rpm in the early thirties and followed the practices used by Kurt Neumann (3). The diagram indicates that 20 per cent of the total fuel was burned in the prechamber in order to supply the energy desired for turbulence to effect the rapid mixture formation in the main combustion chamber. The blowoff energy available from the precombustion chamber is determined by the division of fuel burned in the prechamber as against the total in order to give a pressure differential sufficient to create the velocity necessary for permeating the fuel throughout the main combustion chamber.

Of principal significance is the shaded area shown between the line indicating the fuel injected as against the boundary area showing the fuel burned. The cross-hatched area is of significance in revealing the smoothness of combustion, the speed of combustion, as well as the indications of afterburning. The curves also give data as to the injection lag and the ignition lag and indicate that the time is too short in the prechamber to prepare the bulk of the fuel for combustion in the main chamber. The major vaporization of the liquid fuel must of necessity occur in the main chamber. Here again is a close parallel to the air-injection engine with respect to the course of combustion taking place in the main chamber.

The combustion-velocity curve shows that combustion velocity approaches a maximum very rapidly after the beginning of injection. This indicates the good atomiza-

tion properties needed whereby maximum surface area of the fuel is provided coincident with the maximum temperature. The combustion-velocity curve follows the characteristics of the fuel-injection-rate curve and reaches its maximum at substantially the same crank angle at which fuel injection is completed.

After passing the peak of combustion velocity the injection turbulence in the main chamber drops fast which is immediately reflected in reduced atomization coincident with the reduction in temperature of the cylinder gases. The more quickly the beginning of the ignition is followed by the formation of gas from the disintegration of the molecules, the quicker combustion will be completed and the lower will be the heat losses to the surrounding media.

Direct-Injection Engine

In the direct-injection engine, mixture formation is achieved by an injection system which introduces fuel in suitable droplet size, each endowed with adequate energy, directly into the cylinder. This occurs at the proper time relative to the engine cycle, and in such a shape and with such distribution that it is ready to burn and consume its equivalent of air without producing deleterious or incomplete products of combustion. In operation, fuel is metered and pumped to the injection nozzle at suitable pressures for providing the necessary velocity of entrance. As a general rule, atomization requires a velocity in excess of 500 fps. This in most simple injection systems calls for an atomizing pressure of approximately 1500 psi. In actual engines, however, the problems associated with fuel elasticity, inertia, and the short injection period necessitate energies which often require injection pressures of from 3000 to 25,000 psi. In general, the higher the speed of the engine and the higher the load, the greater the energy required to introduce the fuel in suitable form within the period permissible for satisfactory operation.

The core of the jet consists of fuel moving at high velocity. At 4000 psi injection pressure the mean spray velocity is about 800 fps. Around this core is a zone or mantle containing drops of fuel mixed with air. The velocity is highest at the center and decreases to zero at the interface between the zone of disintegration and the ambient air. In the vicinity of this interface, where the velocity of drops relative to air is low, further mixture of fuel and air occurs. This is accomplished by vaporization of drops having sufficient velocity relative to the ambient (*a*) by reason of organized or general turbulence created by the design of the engine combustion chamber or (*b*) by indiscriminate turbulence occurring in localized regions.

Accomplishing Turbulence. To accomplish organized turbulence in high-output, modern, open-chamber engines the type of combustion chamber as described for the MAN Whisper engine and shown in Fig. 2 is well known. The combustion chamber in the piston crown has a diameter of 50 to 60 per cent of the cylinder bore. In this scheme the air introduced through the inlet valve is given a rotating movement by suitable shrouding of the valve or port at right angles to the axis of the cylinder. On the compression stroke the air is forced into the cup as the piston reaches the top center and the velocities are multiplied in inverse proportion to the diameter of the combustion chamber. The actual speed is more nearly a direct relationship to the inverse of the two diameters. The piston is moved to a minimum clearance between the cylinder head and the piston, practically between 20 to about 40 thousandths of an inch, with the final action of squeezing the air out from between the piston and the cylinder head. The path of the air traveling into the combustion chamber is thereby changed by a superimposed current of air moving out from the space between the upper projection of the piston crown and the cylinder head.

Air Flow in Combustion Chambers

Some interesting experiments have been conducted using models to study the air-flow phenomena in combustion chambers as revealed in Fig. 6. Experiments by Treibnigg (4) and verified in this country utilize a horizontal model in which a piston shape to be tested is provided on a wooden piston. By using a trough for a cylinder, water between the piston crown and the cylinder head is displaced and the turbulence currents are photographed by the reflection of light from aluminum dust on the surface of the water. These are two-dimensional observations but by applying the principle of similitude they can be applied to engine designs. The advantages of these studies readily reveal that optical effects are of much value in shaping the combustion chamber and that the process lends itself to calculations as shown in Fig. 7. Here the velocity and displacement characteristics are distinctly revealed and indicate their

Fig. 6 Turbulence achieved by displacer type of piston

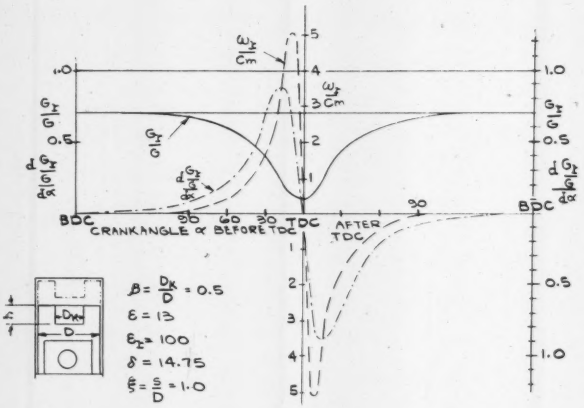

Fig. 7 Characteristic curve of turbulence, velocity, and displacement using displacer type of piston to create turbulence

peaking characteristics close to top dead center. These relationships of course vary with the proportion of the cup in the piston to the cylinder diameter or β in the equation.

In evaluating Fig. 7 one can imagine a diaphragm of diameter D_K projecting above the piston cup through the annular space at W_r to the cylinder head. The curve G_r/G represents, for each crank position α, the proportionate weight of air in the annular space to the total air weight. At TDC, therefore, 60 per cent of the air of combustion is in the piston cavity.

The curve, W_r/C_m, is the ratio of the radial velocity of the turbulence, W_r, through the diaphragm, to the piston speed, and reaches its peak velocity in one direction at 8 deg BTDC and at 8 deg ATDC upon the return stroke of the piston. The dot-dash curve, derivative of G_r over G divided by the derivative of α, is the rate of exchange of air from the annular space through the diaphragm, which reaches its maximum at 15 deg BTDC. The flow into the piston cavity is at a maximum value BTDC as the piston approaches the cylinder head on the compression stroke. The flow is reversed as the piston proceeds on its outward expansion stroke.

The various methods of introducing fuel into the cylinder and the co-operating agencies to produce mixture formation are of interest in developing various combinations. For instance, in the SIGMA free-piston engine a combination of the direct-injection and precombustion-chamber systems is employed. This creates turbulence and improves the combustion and indicates the desirability of co-ordinated timing of turbulence characteristics to combustion sequence in order to achieve the performance desired.

Careful study of Figs. 6 and 7 indicates the opportunities available for introducing fuel in suitable drop-size and spray-formation pattern as needed to achieve desired dispersion when air flows can become most helpful in achieving the distribution of those droplets that have lost their initial velocity. Also indicated are opportunities for achieving the important function of sweeping out the inert used gases from the zone of combustion to permit fresh air to enter that zone and complete combustion of remaining fuel particles.

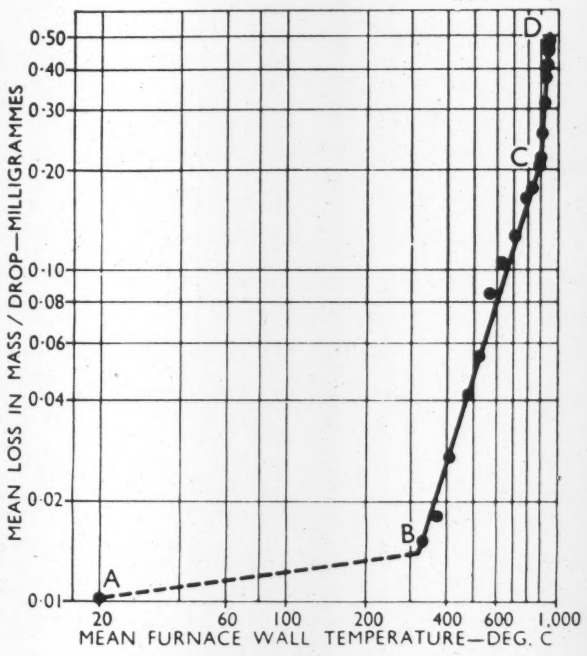

Fig. 8 Professor Davies' evaluation of the regimes influencing combustion of a fuel droplet

Properties of Diesel Fuels

During the past 30 years much has been learned with regard to the specific properties of diesel fuels which cause ignition delay and which adversely affect the rate of pressure increase within the cylinder.

No real satisfactory explanation, however, has been given for self-ignition of fuels. A number of theories still prevail with respect to the factors attributable to self-ignition.

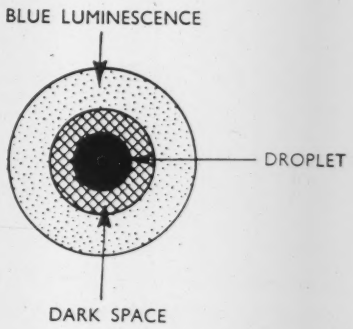

Fig. 9 Professor Davies' concept of combustion of fuel droplet

Some interesting experiments by Prof. S. J. Davies (5) indicate that ignition occurs before 10 per cent of the droplet has been vaporized. After ignition there appears to be a very critical increase in the vaporization rate attributable to the absorption by the droplet of heat released by cracking of the fuel vapors and by the oxidation of the fuel and its vapors. The cracking of these fuel vapors is revealed by the presence of free carbon. The phenomena, whereby the heat, released by this cracking, is transferred to the droplet, and whereby the carbon is mixed with oxygen, ignited, and burned, occur with great rapidity.

This theory by Davies seems to find verification in the new MAN development, the Whisper engine, and also finds proportionate application to other engines as mentioned previously.

Ignition Study. Professor Davies has developed a method for studying the ignition of a fuel droplet. At atmospheric pressure a single fuel droplet of known weight and diameter falls freely through calm heated air at controlled observed temperatures. The droplet is subsequently weighed to determine the percentage which has been vaporized. From these studies a curve has been plotted, as shown in Fig. 8, and this leads him to some conclusions. This curve shows the mean weight loss of the droplet as a function of the furnace itself. Fig. 8 reveals the various regimes which include factors contributing to the combustion of a fuel droplet of a given size. From A to B is a period of time associated with bringing the fuel droplet to the boiling point. From

B to C is that period required to bring it to ignition point, and from C to D is a combustion period revealed by the presence of free carbon. The various points A, B, C, and D are highly significant with respect to the vaporization rates indicated. The observations of Professor Davies led him to the following conclusions: (*a*) ignition starts in the vapor phase, (*b*) carbon appears as a consequence of cracking and heat released by cracking is transferred to the droplet, (*c*) free carbon is in evidence—some of it burns in the vapor trail and the balance under more accelerated combustion conditions, Fig. 9.

Absorption Spectra. Work conducted by Landen (6) on the absorption spectra has proved to be valuable for indicating comparative conditions in a precombustion-chamber engine for the rate of fuel breakdown. Evaporation to the point of the ignition stage of combustion occurs in a 1200-rpm engine at 0.00056 sec after the beginning of injection, but after the combustion has started, the cracking reactions producing the carbon take place in 0.00027 sec or just half the time. These studies reveal the rapidity with which chemical changes take place after the initial ignition period has been started, in the conventional diesel engine.

Supercharging

The improved performance which can be expected with better knowledge of surface-ignition, together with the development of improved techniques for mixture formation, call for careful studies of a third factor, namely, air-charging to improve the cyclic efficiency.

Future developments in diesel engines will tend toward the combination of high supercharge with a proper air-excess, in order to obtain insensitivity to mixing difficulties.

This supports the trend toward compound engines where the excess air at high supercharge with lean-mixture ratios is not lost, but is ultimately picked up in the turbine. This, combined with the fuller utilization of the exhaust-gas energy, will lend impetus to the diesel-heat-generator and turbine combinations.

The more one experiences supercharging in compression-ignition engines, the more attractive it becomes. Differences in fuel qualities tend to diminish and efficiencies tend to increase. Too often, however, the popular idea among diesel-engine designers is to give extravagant emphasis to bmep without due regard to mixture formation for efficient combustion.

In the diesel engine there is a heterogeneous or stratified charge. The mixture ratio varies from point to point in the combustion chamber, from very lean to very rich. A 2000-rpm engine has about 0.003 sec, or around 20 deg of crank angle, in which to complete the mixture formation suitable for combustion conditions. With such a short period of time, and in contrast with a spark-ignition engine, it is practically undesirable to operate at continuous load ratings with low air/fuel ratios in the expectation of satisfactory service results. The over-all air/fuel ratio in a diesel engine can vary from 18:1 at full load and may be greater than 100:1 at no load.

The compound engine provides the opportunity for recapturing most of the energy put into the air even at high supercharged boosts, since expansion is completed to low levels in the gas-turbine portion of the compounded cycle. In any highly supercharged diesel engine, where low air/fuel ratios are attempted under continuous operating service conditions with high-boost air charge temperatures; high heat-transfer rates are demanded through pistons, cylinder heads, and cylinder walls. This is necessary in order to alleviate overstressing of critical engine parts resulting from excessive heating due to afterburning during the expansion stroke. There is urgent need for developing methods for speeding up combustion without creating shock loading.

To achieve longer life in service the efficient application of turbosupercharging is promoted at increasing pressure ratios. This applies to four-cycle engines at present and will be followed by similar treatment of two-cycle engines. In the immediate future a 100 per cent increase in output over atmospherically aspirated engines is readily assured in four-cycle designs. With problems solved at this level of performance there is no reason why the trend will not rise considerably higher, possibly to a multiple of this value, with time. Possibilities prevail for similar advances in two-cycle turbosupercharging resulting in increases of output of 35 to 50 per cent and more. Higher increases will be made available by maintaining cylinder air-charge temperatures at reasonably low levels with a proper balance of excess air.

Fuel Costs

Another facet which must be given exhaustive thinking is that of looking to an enhancement of diesel-engine applicability by the broadening of its capacity to utilize lower-cost fuels to advantage.

In the range of fuel for the diesel there is reason to believe that a fuel between the No. 2 Diesel and the commercial fuel oil will ultimately find broader application in industrial-type diesel-engine power plants.

The availability of larger quantities of residual fuels will result in deeper cracking to reduce the residual-fuel inventory which, in turn, will increase the cracked distillate inventory. Availability of cracked distillates and residual-bearing fuels presents a marketing problem where such fuels may be several cents less than straight-run, high-cetane, diesel fuel.

It is anticipated by some in the petroleum industry that the railroads will set the stage commercially for burning a lower-cost fuel in industrial-type diesel engines. Such a trend should interest the diesel-engine builders in developing fuel-injection and combustion systems which will burn successfully fuels of lower costs in the cracked-distillate category. If diesel fuels create more complicated technology in petroleum refining, it can be expected that diesel fuels will rise to still higher costs. The more readily producible and marketable fuels will be the fuels in the lower-cost bracket.

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The Economics of Combustion

By E. G. Bailey

Past-President of The American Society of Mechanical Engineers

The assignment to give a dinner talk at Cambridge on June 16, 1955, in connection with the International Conference on Combustion, led the author into some study of facts and statistics bearing on the latest available progress within this field. As some of these data are not usually assembled in one place, it seemed best to arrange the facts from which the talk was given and make them available to those interested.

PRACTICALLY every one of our many engineering activities is related, directly, or indirectly, to energy. We may classify these activities broadly as:

1 Recovery, preparation, and processing of fuel.
2 Equipment for the generation of energy from fuel and from hydro projects.
3 Operation of power-generating equipment and all processes using direct heat.
4 Process machinery and power to drive same for all types of end products.

At present this energy comes largely from the combustion of fuel in its original state, as with coal or natural gas, or after processing it, as in the case of petroleum products, coke, manufactured gas, or waste fuels from industry.

From the days of Newcomen, Watt, Stephenson, Fulton, and Corliss, until the day of Edison, the increase in the use of energy was gradual but firm. Since the commercial development of electricity generation and the internal-combustion engine, together with improved alloys through metallurgy, the advance has been at an accelerating pace, a sort of chain reaction as it might be called today.

The use of energy will undoubtedly continue to increase for many decades before its rate of increase slows down to the inevitable pattern of the fundamental growth curve. The introduction of nuclear energy and the possibility of harnessing the sun are likely to add only an incremental portion to the total in the foreseeable future, and are not likely to quickly change the present trend of obtaining additional energy from fuel.

Combustion of fuel has become highly specialized, both as to the processing of fuel for various uses and the detailed combination of thermal reactions and the equipment which governs the generation and use of heat therefrom.

When the market for one kind of fuel lags or the prevailing method for its use becomes obsolete, it is time for someone to step ahead with invention, research, and development, in keeping with the good old individual competitive enterprise system which brought us to where we are today.

Everyone responsible for the burning of fuel endeavors to obtain complete combustion and high thermal efficiency. Other important factors of costs and adaptability to the purpose in hand enter into the over-all economics of any particular use. Perhaps some concrete illustration will enable us to better understand what has been accomplished and what further work is needed.

Automobile Engine

The automobile is a simple case of the combustion of fuel and the development of energy for transportation, all in one unit. I say it is simple because we all know how to operate it to our own satisfaction and it furnishes us with convenient transportation at a cost which we seem eager to pay. The large and ever-increasing number of motor vehicles in use proves the point.

The attainment of this simple and reliable means of converting fuel energy into transportation through combustion was not simple by any means. The automobile of today is the product of sixty years of intensive and effective work by thousands of competent people through invention, research, and development, working under our system of highly competitive enterprise.

To utilize fuel through combustion there are three essentials:

1 A supply of suitable fuel.
2 Equipment in which the fuel can be burned satisfactorily and means for injecting the fuel and the proper supply of oxygen from the air or, in special cases, from other sources.
3 Equipment whereby the heat from combustion can be transmuted into the desired end product.

In the automobile the pressure of the expanding gas moves the pistons, resulting in transportation. In other cases it may be kilowatts of electricity, pumping of fluids, space heating, or metallurgical or other processes. Items 2 and 3 involve investment in equipment and machinery with additional costs for operation, maintenance, fixed charges, and amortization. These costs may vary greatly with the nature of the fuel to be burned, the space and weight limitations available for the equipment, the reliability of operation, the load factor, and the efficiency. To these operating and fixed charges must be added the cost of fuel itself.

It would seem logical to use the lowest-cost fuel available, but often it is more economical to buy a specially prepared fuel at a higher price for the best over-all results. Such is the case with the automobile. The equipment has been designed for quick starting and responsive control. It must conform to space and weight

Basis of an address delivered at the Banquet, Cambridge, Mass., June 15–17, 1955, at the International Conference on Combustion sponsored by The Institution of Mechanical Engineers (London) and THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, in co-operation with the Office of Summer Session of Massachusetts Institute of Technology.

limitations. To aid in meeting these requirements, a special fuel, high-octane gasoline, has been developed. The engine and the fuel have been improved and adapted to each other as the most economical combination.

At the Golden Anniversary of the Society of Automotive Engineers in January of this year, T. A. Boyd, discussing the topic of Co-Operative Research, quoted from the *SAE Journal* of September, 1919, in which C. F. Kettering, as the automotive-industry representative on a joint committee with the petroleum industry, said: "The fuel problem has an automotive-industry side and a petroleum-industry side, and a complete solution is impossible without the hearty co-operation of both industries."

The obvious result of the progress to date, shown in Table 1, is about 60 million motor vehicles on our highways. There are new motor cars, including trucks and buses, coming out at the rate of about 7 million per year, as some 5 million disappear to the scrap pile.

Table 1 Automobile Registration in the United States, Gasoline Consumption, and Cost Estimates

		1953	1954
1	Registration of motor cars in U. S.	56,279,864	58,589,863
2	Motor fuel consumed, gal	47,381,037,000	48,996,000,000 (est)
3	Average prices paid, cents per gal[a]	21.4	21.5
4	Total cost motor fuel (approx)	$10,100,000,000	$10,500,000,000
5	Motor-fuel tax, Federal	833,049,000	948,581,000
6	Motor-fuel tax, State	2,145,471,000	2,295,228,000
7	Total motor fuel cost with taxes (approx)	$13,079,000,000	$13,744,000,000

[a] Data from: Retail Service Stations, 50 cities—U. S. Dept. of Commerce. Other data from Bureau of Public Roads and other sources.

The total cost of automobile fuel last year was over 13 billion dollars, more than 3 billion dollars of which went for federal and state taxes, collected at the quarter of a million filling stations scattered along 1.5 million miles of highways. It has been said that if all of these motor cars were run continuously at normal full load, they would consume a year's supply of fuel in one week. This means that, on the average, our cars are running at a time-load factor of about 2 per cent, as compared with 60 to 80 per cent in the central electric generating stations.

Electric-Power Generation

Passing now from the 60 million car owners, who spend an average of about $700 per car per year, and the 70 million licensed drivers, each of whom averages about 300 hr per year at the wheel, we pass on to the problems of combustion of fuel to supply electrical energy to the 51 million homes and other users at the current rate of 410 billions of kilowatthours for the very reasonable sum of $7^1/_4$ billions of dollars, an average of 1.77 cents per kwhr for all purposes.

This service is available to you, in every room of your house, for 8760 hr per year, minus a few hours when hurricane Carol or Hazel exerts more energy than the entire electrical system. This service is at your beck and call without your exerting any effort, or wasting any time, unless you are using it on television. At any rate, the total cost to the average residence is about $70 per year, at 2.69 cents per kwhr.

The electric-utility industry has been very active in rendering reliable service at the lowest possible cost. Stationary plants have no serious limitations with respect to weight and space of the power-generating equipment selected for this purpose. Within the area which each serves, the plant location is usually selected with respect to a suitable water supply, and also for the most economical fuel and its transportation and local handling.

The fuel-burning equipment is chosen with respect to burning efficiently the fuel most readily available, which may be coal, oil, natural gas, or sometimes waste fuel, such as blast-furnace gas, or oil-refinery residue. There has been marked improvement in the combustion efficiency so that now it is very close to 100 per cent, with a minimum of excess-air losses. The over-all boiler efficiency is often about 88 per cent on the basis of high heating value. The greatest gain in over-all efficiency is through the use of steam at higher pressures and temperatures of superheat, together with improved turbine performance and heat recovery through stage heating from bled steam.

Fifty years ago about 6 lb of coal were burned for each kwhr generated; this was reduced to 2 lb in 1925; and last year all fuel-burning plants averaged 1 lb of coal per kwhr. This means an increase in over-all thermal efficiency from 4.5 per cent to 28 per cent, with some of the latest coal-burning plants operating about 38 per cent thermal efficiency.

During the period when the thermal efficiency was being increased, the cost of fuel doubled, cost of labor and equipment went up, and inflation had its influence on costs, but engineering progress was responsible for a decrease of 30 per cent in the net price of kilowatts to residential users on at least one system, while the cost of living has increased 50 per cent.

Other important factors affecting reduction in costs are less man-hours per kwhr through instrumentation and automatic control, and larger units resulting in savings from otherwise higher costs in main equipment and auxiliaries.

Data are shown in Table 2 comparing certain selected items from the Sixth Report of the British Electricity Authority[1] operations for the fiscal year ending March 31, 1954, with those of the Federal Power Commission giving the complete operating and financial data for 1953 operations of the Investor-Owned Electric Utilities in the United States. There are also included a few items relating to the total electric-power generation in the United States for 1953 from the Advance Release of data from the Edison Electric Institute.

Comparing the fuel-burning plants alone, the BEA operated at 23.4 per cent thermal efficiency as compared with average in United States for Investor-Owned plants of 26.5 per cent. The best plants in Britain have 30.9 per cent thermal efficiency and in the United States 38.5 per cent. Coal in Britain cost $7.88 per ton of 2000 lb and $6.30 in the United States. The Btu per lb of British coal is slightly lower, so that the cost per million Btu was 36.6 cents versus 26.0 cents in the United States. Total income from sales was 1.60 cents per kwhr in Britain versus 1.84 cents per kwhr or 11.5 per cent higher in the United States, while the fuel cost was 19 per cent lower on a Btu basis.

However, from the total sales receipts, the United States companies paid out 20.5 per cent in taxes and

[1] Now Central Electricity Authority.

Table 2 Comparison of Electric-Power Generation and Use—British Electricity Authority for Year April 1, 1953, to March 31, 1954, Versus Investor-Owned Electric Utilities, U.S.A., Year 1953

	BEA	IOEU	Total electric utilities in U. S., 1953
Total generation, million kwhr	62,121	353,328	442,665
Water power	420	52,143	105,233
Steam	61,658	300,486	333,542
Internal-combustion	43	699	3,890
Purchased and interchanged	634	68,619	
Transmission and other losses	6,908	39,598	
Total sales to ultimate users	55,847	308,674	384,244
Income from sales, $1000	894,793	5,692,358	6,793,660
Income from sales, cents per kwhr	1.60	1.84	1.77
Fuel cost, $1000	328,656	1,003,543	
Fuel cost per kwhr from fuel, cents	0.494	0.330	
Btu per lb coal used, equivalent	10,792	12,170	
Btu per kwhr generated	14,580	12,886	
Coal per kwhr generated, lb	1.352	1.059	
Thermal efficiency station output, per cent	23.4	26.5	
Price of coal per 2000 lb, dollars	7.88	6.30	
Cost fuel per million Btu, cents	36.6	26.0	
Variation cost per million Btu, cents	..	8 to 55	
Fuel cost, per cent of sales income	36.6	17.6	

			—Comparison[a]— BEA	IOEU
Operational Data				
Total sales, all services, $1000 U. S.	911,533	7,136,337	5,050,000	7,136,337
Taxes federal and other, $1000	..	1,465,768	..	..
Other costs and charges not detailed	..	..	..	..
Net profit, $1000	36,928	1,030,225	204,000	287,000
Net profit, per cent	4.04	14.4	4.04	4.04
Total investment in system at end of year, $1000	3,059,252	28,645,679	16,950,000	23,900,000
Capital invested in new facilities during current year, $1000	430,808	2,916,339	2,390,000	3,360,000
Increase in capital investment, per cent of total investment	16.4	11.3	16.4	16.4

NOTE: Conversion to U. S. dollars on a basis $2.80 per pound sterling.
Conversion to U. S. tons at 2000 lb from 2240 lb British ton.

[a] Comparison of BEA with U. S. Investor Owned:

On basis of same kwhr sales or Col. 1 times $\frac{308674}{55847} = 5.54$

On basis of same total dollar sales or Col. 1 times $\frac{7136}{911} = 7.81$

Table 3 Detailed Financial Operations

	BEA, 1953–54		IOEU, 1953	
	$1000	Per cent	$1000	Per cent
Income from sales kwhr	894,793	98.3	5,692,358	79.8
Total sales all services	911,533	100.0	7,136,337	100.0
Operating expense	641,278	70.3	3,734,426	52.3
Depreciation and amortization	136,483	15.0	618,002	8.7
Taxes, federal on income	..	..	865,080	12.1
Other taxes	..	..	600,688	8.4
Total operating deductions	777,761	85.3	5,818,196	81.5
Net operating income	133,770	14.7	1,318,142	18.5
Income from other sources	2,831	0.3	51,297	0.7
Gross income	136,601	15.0	1,369,439	19.2
Interest, financing, and similar costs	99,673	10.9	339,214	4.8
Net profit	36,928	4.04	1,030,225	14.4
Dividend on preferred stock	..	..	137,802	1.9
Dividend on common stock	..	..	642,596	9.0
To surplus	36,928	4.04	249,827	3.5

British none. The net profit in the United States was 14.4 per cent as compared with 4.04 per cent in Britain. It should be remembered that the dividends paid out of the profit in the United States are for the use of capital invested. Additional profit is retained for reinvestment for the benefit of the stockholders.

Table 3 shows some selected items from the financial statements of the British Electricity Authority (BEA) and the Federal Power Commission's Annual Report on the Investor-Owned Electric Utilities of the United States.

In Britain 98.3 per cent of the total sales is from kilo-

watthours, while in the United States 79.8 per cent is from this source.

The items of interest on finances, depreciation, and amortization are 25.9 per cent in Britain and 24.4 per cent in the United States. The latter includes dividends on the preferred and common stock of 10.9 per cent. In the United States taxes are 20.5 per cent and in Britain none.

Another item of interest is the transmission losses from the distribution of electricity. The data show these to be 12.4 per cent in Britain versus 12.8 per cent in the United States.

The total investment in the United States plants was $28^1/_2$ billion dollars, or four times the total sales, while in Britain the total investment was 3.4 times the total sales.

Investment during the current year for new facilities was 2.9 billion dollars in the United States and 2.4 billion dollars in Britain, on equivalent kwhr output. This was about three times the net profit in the United States and more than eleven times the net profit in Britain.

Passing now from the production end of the electrical industry to the users, we note from Table 4 that in both countries there is one residential customer for approximately each four people of the total population. In the United States each residential customer uses an average of 2549 kwhr per year at 2.69 cents per kwhr, or about $70.00 per year. In Britain they use about one half the kwhr at 1.78 cents per kwhr, or two thirds the cost, and a total electric bill of $23.40 or about one third that of the United States average residential user. The industrial customers in Britain pay 1.34 cents per kwhr, as compared with 1.05 cents in the United States, but the total cost per year per British user is just about one half that paid in the United States.

Table 4 Comparison of Electric Power Used by Residential and Other Consumers in Great Britain and the United States[a]

	Great Britain 1953–54	United States 1954
Residential consumers		
Total number	12,624,141	43,139,998
Power per user per year, kwhr	1,310	2,549
Cost per kwhr, cents	1.78	2.69
Average cost per user per year	$23.40	$68.57
Combined residential, farm, and commercial		
Total number	14,219,815	50,769,119
Power per user per year, kwhr	1,790	3,782
Cost per kwhr, cents	1.92	2.59
Average cost per user per year	$34.40	$98.16
Industrial		
Total number	163,899	445,440
Power per user per year, kwhr	185,420	491,400
Cost per kwhr, cents	1.34	1.05
Average cost per user per year	$2,475	$5,150
Total ultimate consumers	14,383,714	51,214,559
Power per user per year, kwhr	3,890	8,127
Cost per kwhr, cents	1.60	1.77
Average cost per user per year	$62.80	$143.55

[a] Data from British Electricity Authority, Sixth Report, and Edison Electric Institute, Advance Release 1954. Conversions are at the rate of $2.80 per pound sterling.

Marine Power

A ship at sea is a self-contained unit, and since the day of the passing of sails it has been powered from the burning of fuel. Coal-fired boilers and steam-engine drive reigned supreme until the advent of the steam turbine. Then a general change from coal to oil took place during the past fifty years. Coal is still used extensively on the Great Lakes and in some of the older ships at sea, such as tramp steamers.

The steam turbine is used in large ships, like the *Queen Elizabeth* and the *United States*. The diesel engine has become almost universal in new ships below 5000 hp. There is wide diversity of opinion as to the best motive power for ships of more than 5000 hp up to some indefinite limit where experience and judgment will control the future.

The solution depends greatly upon fuel costs and efficiency. It is not a simple question of the cost of bunker C or No. 6 fuel oil under boilers and standard grade of diesel fuel in engines, for some of the bunker C is troublesome as to deposits in the boilers and corrosion of air heaters, while the diesel-engine builders are striving toward the economical use of a lower-cost fuel, approaching bunker C.

There are other factors to be considered beside fuel cost, such as reliability, initial cost of power plant, its weight, and space occupied, cost of operation and maintenance. Maneuverability is very important for some classes of service.

Locomotive Power

The history and power requirements of the locomotive are somewhat similar to those of marine power. The reliability factor is not so important, but space and weight restrictions are of greater importance. The load factor is lower so that initial cost is relatively more important, and load variations are in the same class as an automobile. The fuel costs are important, as is cleanliness of stack discharge.

The history of the locomotive power plant started with Stephenson and Trevithick—a wood-burning steam boiler and reciprocating steam engine. The fuel was soon changed from wood to coal, and much later to No. 6 residual fuel oil in certain areas where it was cheaper.

Railroads are more adaptable to electrification than for any other means of transportation. Electricity has been used extensively, but initial costs are so high that it is economical only where there is a heavy density of traffic and, to some degree, where atmospheric pollution is important. Several short stretches of electrification made several years ago have recently been abandoned.

The diesel locomotive has practically run away with the show during the past 10 or 12 years, and now the railroads in the United States spend about 67 per cent of their total energy bill for diesel fuel and about 5 per cent for kilowatts for electric locomotives. About 17 per cent is for coal and 6 per cent for No. 6 fuel oil generating steam in the old iron horse. About 5 per cent is for gasoline, anthracite, and other fuel.

Power for Transportation

Three means of transportation have been reviewed briefly, the automobile, locomotive, and marine. While they are different in many ways, there is the common problem of burning fuel to propel the power plant itself plus a pay load or cargo, all contained in some form of mobile unit.

The problem is not one of combustion alone, but of the complete combination and relationship of one part to the other, as is best illustrated by the automobile. The automobile is successful and satisfactory because the engine and the fuel have been highly specialized for each other and the user is willing to pay about $2.00 for each million Btu which is put into the tank. Diesel fuel costs 70 to 80 cents per million Btu, and is priced fairly uniformly throughout the country. In areas where some of the heaviest railway traffic is carried, coal is available at 18 to 25 cents per million Btu. In the southwest and along the seaboard, residual or No. 6 fuel oil is available at 25 to 35 cents per million Btu.

For marine purposes, where the diesel fuel is $2^1/_2$ times the cost of No. 6 fuel oil, the competition between diesel and steam turbines will continue on a close basis as at present.

For locomotive use, the diesel-fuel Btu cost is now about three times the coal Btu cost. When the diesel-locomotive activity began some 12 years ago, diesel fuel cost less than half of today's price, and the price of coal was about 60 per cent of today's price, so that with the thermal efficiency of the diesel more than four times that of the conventional coal-burning steam locomotive, the saving from the use of diesel was very marked, as the records show.

Some interesting data relating to the use of fuel and energy for transportation are shown in Table 5. The first four items relate to the total operation of all freight locomotives, as reported by the Interstate Commerce Commission for the entire year of 1954, with a fuel consumption cost of about 273 million dollars. These data are averages without detailed data as to whether or not the service conditions were sufficiently alike for the different kinds of fuel and equipment to be comparable. Expressed in gross ton-miles (gtm) per dollar fuel cost, they range from diesel 6000, coal-fired steam 3400, electric 3270, and oil-fired steam 2140.

Another set of data from the Norfolk and Western Railway[2] covers coal-burning locomotives in freight service. Their reciprocating locomotive Y6b performance gave 4600 at 22.6 mph on a heavy grade, and the Class A reciprocating engine gave 7900 at 34 mph on a fairly level track. A coal-burning noncondensing steam-turbine-electric locomotive gave 6640 at 20.4 mph on the same steep grade run and 11,320 at 29.7 mph on the fairly level run of identical mileage with the reciprocating engines. In all direct comparisons the steam-turbine locomotive gave performance 44 per cent better than the reciprocating engines, and 38 per cent better than the I.C.C. data for the diesel average of the country.

The N&W reciprocating locomotives were only 3 per cent below the I.C.C. diesel data and 71 per cent better than the I.C.C. coal-burning reciprocating steam engines.

These comparisons should be taken with caution because the conditions may not be sufficiently alike to warrant definite conclusions, but they are worthy of further study.

One often reads or hears statements to the effect that freight transportation by rail costs one third as much as by motor truck. More details should be listed before worth-while conclusions can be reached.

Items 9 and 10 in Table 5 give some other authoritative data in transportation by tankers of the Atlantic Refining Company,[3] where the SS *Van Dyke* moved 15,975 gtm per dollar at 13.5 knots while a newer tanker, SS *Atlantic Navigator*, moved 12,800 gtm at 18.2 knots. It must be remembered that the power required to propel

Table 5 Comparison of Some Fuel Data Relating to Transportation

	Locomotive	Units per 1000 —gross ton miles— Fuel and power consumed	Cost of fuel used, cents	Price per unit of fuel or energy	Cost per million Btu in fuel, cents	Gross ton miles per dollar of fuel cost	Average speed, mph
1	Coal—steam.....	110 lb	29.42	$5.35/ton	20.5	3,400	
2	Oil—steam.....	9.92 gal	46.53	$1.96/bbl	31.0	2,140	
3	Electric.....	27.0 kwhr	31.19	1.55¢/kwhr	338.0	3,270	
4	Diesel.....	1.68 gal	16.75	9.97¢/per gal	72.0	6,000	
5	Coal—SteamY6B....	72.5 lb	21.77	$6.00/ton	23.0	4,600	22.6
6	Coal Steam A.....	42.6 lb	12.59	$6.00/ton	23.0	7,900	34.0
7	Coal Steam Turbine.	50.1 lb	15.05	$6.00/ton	23.0	6,640	20.4
8	Coal Steam Turbine.	29.9 lb	8.83	$6.00/ton	23.0	11,320	29.7
	Tanker						**Knots**
9	Oil—steam-turbine-electric.....	26,850 dwtm / bbl		4¢ gal (est)	26.0	15,975	13.5
10	Oil—steam-geared turbine.....	21,500 dwtm / bbl		4¢ gal (est)	26.0	12,800	18.2

Source

1–4 Interstate Commerce Commission, total year 1954.
1 Road, freight service, 9,281,000 tons of coal consumed.
2 Road, freight service, 7,332,000 bbl bunker C fuel oil.
3 Road, freight service, 716,406,000 kwhr.
4 Road, freight service, 48,000,000 bbl diesel fuel.
5–6 Steam locomotives, Norfolk and Western Ry., ASME Paper No. 54—A-251.
7–8 Steam-turbine-electric, Norfolk aud Western Ry., ASME Paper No. 54—A-251.
9 Atlantic Refining Co., SS *J. W. Van Dyke*, ASME Paper No. 55—S-37.
10 Atlantic Refining Co., SS *Atlantic Navigator*, ASME Paper No. 55—S-37.

[2] ASME Paper No. 54—A-251.
[3] ASME Paper No. 55—S-37.

a ship varies approximately as the 2.8 power of the speed. The lowest power consumption required to move a ship is by wind and sail if you can afford to pay for the operating costs and the capital charges on the ship and cargo during the additional time required.

The cost of transportation is one of the most interesting of the many problems involving the use of energy from combustion.

The competitive problem on a locomotive is to increase the efficiency of the coal-burning steam locomotive as has been done in the large stationary electric-generation stations and in marine practice. The space and weight limitations are more restrictive, so that the turbine-electric efficiency may not be able to exceed 15 per cent condensing, or approximately half that of the diesel, but with coal Btu cost less than one third that of diesel fuel there is a fair incentive for active work in improving the use of coal-fired locomotives.

The gas turbine is making headway in both marine and locomotive applications. So far as actual service is concerned, the fuel used has been within the range from diesel grade to residuals of varying specifications, with varying degrees of success. Intensive work also has been carried on toward the development of a pulverized-coal-fired gas turbine, with promises of some real competition from this system.

Within the marine and stationary fields there may be a combination of gas turbine and steam cycle using a suitable fuel.

Miscellaneous

Very large quantities of fuel are used for space heating and for metallurgical and other processes. In some cases the market is highly competitive, which means that more research and development are needed in cases of a losing position, or when the supply of a given quality of fuel is limited and steps should be taken to find a substitute. Low-sulphur high-grade coking coal is an illustration, with limitations in the supply throughout the world. Pennsylvania anthracite contains a different form of carbon but it is low in sulphur content and ingenuity should develop some kind of process whereby anthracite could be used more extensively for many metallurgical purposes.

With the progress being made toward reducing the cost of electricity in face of the increase in the cost of fuel for direct heating, where little or no increase in efficiency is possible, there will be increased opportunities to use more electricity for the direct application of heat. For its heating value alone, at 1 cent per kwhr, it costs $2.93 per million Btu. Gasoline costs $2.25 per million Btu. The oxyacetylene flame costs $23.00 per million Btu and it is used extensively as a cutting torch, and for other special purposes. Fuel costs alone do not render the final verdict in many cases.

Summary

Space limitations have permitted the presentation of only a few figures and conditions where combustion plays an important part in generating power for electricity and for transportation. In addition to the central-station power generation, there is, perhaps, double the amount of fuel used in plants with similar equipment for industrial power units. Space heating and process steam is another large requirement which we will not even touch upon now.

Coal-Combustion Problems. History and future problems relating to the burning of coal, anthracite, and lignite are of importance because we have our greatest fuel reserves within these fields. Of these, bituminous coal is the active fuel of the day with many and diversified uses and problems. In spite of its price increasing from about one dollar a ton at the mines sixty years ago to nearly five dollars today, it furnishes us with an abundant supply of fuel at the lowest cost per Btu of any now available.

The method of firing has changed from hand firing, through many different kinds of stokers, to pulverized coal for the major tonnage today. The cyclone furnace is the latest development, but even the old-style chain grate for steady load and the spreader stoker for variable load, both with self-cleaning grates, are well adapted to small unit service, and each has its economic place today.

Formerly, the principal trouble from burning coal was smoke from incomplete combustion and clinkers on the grates. Our increased knowledge of combustion and means for control has eliminated the sooty smoke, and the ash is no longer troublesome on the grates, but it now gives plenty of trouble dirtying the heat-absorbing surfaces and clogging the gas passages in many cases. Then there is the atmospheric-pollution problem if the ash is not removed by collectors.

So long as there are a great many of the same troubles from the burning of residual fuel oil with only a small part of one per cent of ash, it is hopeless to try to remove the ash from the coal sufficiently before firing it. The most effective method so far toward reducing this trouble is the cyclone furnace. It removes about 85 per cent of the ash as liquid slag directly from the fuel-burning zone very effectively. Future development should be in the direction of increasing the ash removal in this form and also removing in a similar manner a larger proportion of the sulphur.

The problem of slag adhering to heating surfaces and clogging gas passages can be minimized by carrying the gases through the critical zones at reduced temperatures.

Residual Fuel Oil. The small amount of ash in certain kinds of residual fuel oil is very troublesome in coating the tubes, reducing heat absorption, and also causing corrosion in certain zones. The best remedy found so far is the addition of dolomite or some other suitable additive which will change the properties of the ash to be less troublesome.

Sulphur and other similar corrosive compounds are objectionable in all kinds of fuel containing them. Acid-resistant coatings are being applied to air-preheater tubes, and the like, with promising success.

With gasoline and diesel engines and gas turbines using ash-free fuel, the prevalent trouble is still deposits, but from the breakdown of the fuel itself resulting in carbon deposits. The improvement so far seems to be in the direction of better combustion and the word "additive" seems to appear more frequently in the current literature on problems relating to these prime movers.

Atmospheric Pollution. Atmospheric pollution is a problem of increasing importance, not because of poorer combustion than formerly, for actually we are doing much better from equal tonnages of fuel burned. We are burning so much more fuel and the population centers are increasing in density, and some of them are located in areas with poor natural atmospheric conditions for scavenging the pollution away.

Even the automobile engine is under attack as a source of pollution. There is no doubt but that improvements will be made without serious delay. There is an important challenge for each of us to do his utmost to make the discharge from every form of combustion as free as possible from polluting conditions.

Economic Combustion of Fuels. Let us raise our vision with respect to combustion. It is not just hydrocarbons plus air equal to CO_2, H_2O, and nitrogen; it is all of that plus the cost of the lowest-priced fuel suitably available, plus the cost of the equipment needed to bring about complete combustion at the temperature and conditions desired, plus the cost of the equipment needed to transmute the heat energy liberated into direct application to a chemical or metallurgical process, or to create a velocity which can be efficiently directed toward turning the wheels of industry through the generation of electricity, the transportation of fluids through pipe lines, or the driving of automobiles over highways, ships over the seas, or planes through the air.

There is need for a great deal more accomplishment within this field of economic combustion of fuels. Progress should be made with more open-minded realization of facts versus traditions and opinions. There should be continued research with more wisdom, and it should bring about more new inventions, effective development, and final commercial accomplishments.

The total cost for fuel in the world is tremendous and it is rapidly increasing. Many uses have not been mentioned. The older and less spectacular ones, such as house heating, small power plants, many processes in the ceramic and metallurgical fields using direct heat, and the currently active and progressive field of aviation, are equally as important as are industries and uses which have been discussed as illustrative.

We are all familiar with kilowatts, and with transportation by automobile, railroads, and water, and there are more interrelated problems in economic combustion between them than with the others. Furthermore, they are more standardized and reliable data are more readily available.

Fuel Costs in the United States. Some interesting figures to remember are:

In the United States we paid about $10^1/_2$ billion dollars last year for motor fuel, plus over 3 billion dollars for federal and state tax on same, making a motor fuel bill of $13^3/_4$ billion. It has been estimated that the total operating cost of our present fleet of motor vehicles is about 40 billion dollars per year, not including cost of investment in new cars. On this basis the fuel cost is about 34 per cent of the total annual cost.

Our electric utilities last year had a total revenue from the sale of 410 billion kwhr of a little over 9 billion dollars; the fuel cost of the 75 per cent of this power generated in steam plants was about 1 billion dollars, or about 16 per cent of the total sales value.

The Class I railroads in the United States during the past three years had a total average income of just over 10 billion dollars per year, and a total fuel cost of slightly under one-half billion dollars, or less than 5 per cent of the total income.

The fuel cost for generating 75 per cent of all of our kilowatts in the electric industry and running all of our Class I railroads adds up to 1.5 billion dollars, while our gasoline bill for motor vehicles is over 13.5 billion, or 9 times the cost of fuel for the power stations and railroads combined.

More Economic Use of Fuels. The automotive industry is progressing toward better economy through higher-compression engines. Superchargers are being added to diesels and the engine adapted to lower-cost fuel. The petroleum industry is working toward higher-grade fuels and a lesser percentage of residue.

The gas-turbine development is progressing, but mostly within fields competitive with the diesel, with possible restriction to better grades of fuel.

The large steam plants on land and sea have exceeded all other power units in thermal efficiency using a wide range of fuel, so that advantage can be fully taken of the fuels with low-cost Btu, thereby setting a high record on fuel economy.

Better use of our large anthracite and coal reserves is greatly needed, especially for special purposes now filled by fluid fuels, such as natural gas and petroleum.

In the long-range future some predict that within twenty years, our total energy consumption will have more than doubled, and the greater part of the increase may need to come from coal, used mostly in its natural state and some processed to fluid fuel.

Electrical-Power Industry. The substantial improvement in the steam turbine-electrical generating cycle of the central-station industry burning coal, residual oil, or other low-cost raw fuel, by improving the thermal efficiency from 4.5 per cent to 38.5 per cent as of today, has been brought about through advanced engineering accomplishment by many in a few branches of our individual-enterprise system.

The electrical industry has pioneered in buying equipment of advanced design from progressive manufacturers, and both have co-operated in operating their power plants for the best performance, and have obtained data and experience for still better results in the next extension of the ever-growing systems. These groups have been favored in many ways and have the advantage of dealing with primary factors easily measurable with accuracy, such as the calorific value of the fuel, temperatures, rates of flow of fluids, rates of heat transfer, properties of materials, and, above all, a product, the kilowatt, which is exactly uniform in heat-energy equivalent and is accurately measurable.

Another very important contributing factor is the greatly expanding use of electricity, so that utilities could build new plants frequently to meet these demands, and at reduced cost to the ultimate user, without the need for any stilted yardstick or subsidized benevolence.

Transportation. In the field of transportation for the individual person, to satisfy his desire to come and go as he pleased, there was a crying need for the automobile which has had a meteoric development and growth in the hands of individual enterprisers serving those who are willing to buy and use fuel-burning equipment in a way to suit their pleasure with no measurements but "miles per hour" and "fill 'er up."

Between these two successful extremes of the lowest and the highest cost per horsepower hour, we have many industries and needs for energy from the combustion of fuel which have not followed at the same tempo. There are many excuses and some reasons for not making similar progress in other lines, but with a careful analysis of the history of accomplishments of others, my suggestion is, go and do likewise with carefully selected methods for any useful purpose.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*

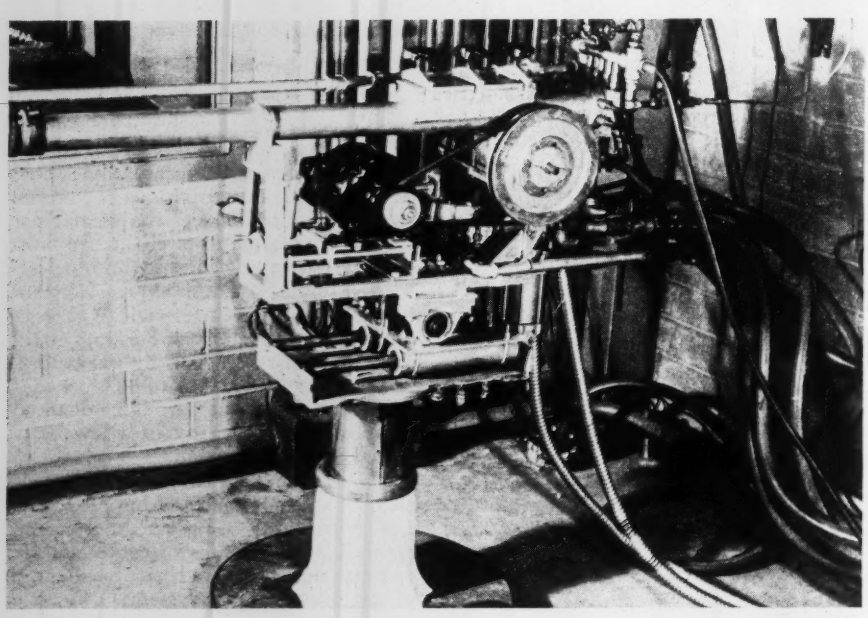


Fig. 1 The Flame-Plating gun consists of a barrel and a mechanism for loading precise quantities of oxygen, acetylene, and tungsten-carbide powder into the firing chamber. It is aimed and fired by remote control from a central board outside the firing chamber.

Flame-Plating

FLAME-PLATING was developed by Linde Air Products Company's Acetylene Research Laboratory in Speedway, Ind., as part of a broad project to discover what constructive use could be made of detonations in gas mixtures containing acetylene. This was several years ago.

Since then, the Flame-Plating process has gone through the usual stages of development until at the present time it has become a valuable tool in solving many of industry's most troublesome wear problems.

Currently, tungsten carbide is the only material which is being commercially Flame-Plated. Several other coating materials are in the development stage which, when perfected, will increase the importance of this process in modern industrial practice.

Key to Linde's unique and revolutionary Flame-Plating process is controlled detonation. Flame-Plating is a surfacing method in which particles of tungsten carbide are literally blasted onto the surface of a workpiece. (The tungsten carbide is composed of tungsten, carbon, and 8 per cent cobalt.) This is accomplished through the use of a specially constructed gun. The gun consists of a barrel and a mechanism for loading precise quantities of tungsten-carbide powder, acetylene, and oxygen into the firing chamber. The tungsten-carbide powder remains suspended in the explosive gases until a spark ignites the mixture producing heat and pressure waves. The confining shape of the barrel concentrates these waves in a small area producing a tremendous heat and pressure build-up. When the temperature reaches 6000 F, the heat waves begin to move faster than the pressure waves. This phenomenon is detonation. The heat wave, also known as the detonation wave, rips through the gas-powder mixture at ten times the speed of sound, completely burning the gases and leaving behind a solid block of pressure in which the tungsten-carbide powder is suspended.

Pressure inside the barrel reaches 10,000 psi in 0.003 sec. When the detonation wave leaves the muzzle of the gun, it is like pulling a gigantic cork out of a volcano. The detonation wave turns into a shock wave and dissipates into the air. The gases, jammed inside the barrel, burst out carrying the tungsten-carbide powder with them. This is actually a backward movement, called refraction. First, the pressure at the mouth of the gun breaks loose, which allows gas farther back to rush out, and so on back along the length of the barrel. The particles of tungsten carbide become partially molten

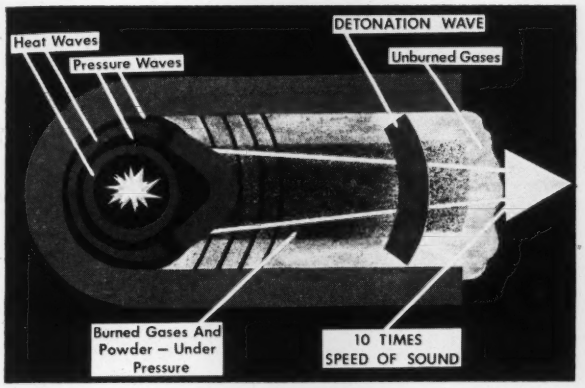


Fig. 2 Detonation diagram. A spark ignites the mixture of oxygen and acetylene gases producing heat and pressure waves. At a certain point the heat waves begin to move faster than the pressure waves. This is detonation. The heat wave rips through the gas and powder mixture leaving a tremendous pressure build-up in its wake. When the pressure block bursts out of the barrel, the tungsten-carbide powder is hurled at supersonic speed at the workpiece surface.

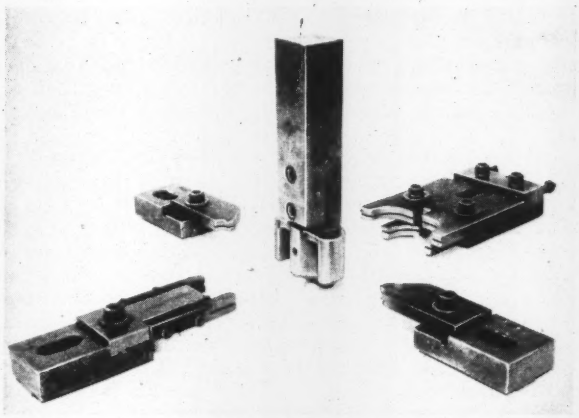


Fig. 3 Surfaces and grooves of these wire-forming mandrels which come in contact with the spring-wire stock have been Flame-Plated for extra wear resistance. One manufacturer reports that the Flame-Plated tools last 10 times longer in service than hardened tool-steel parts. Production has also been increased 74 per cent.

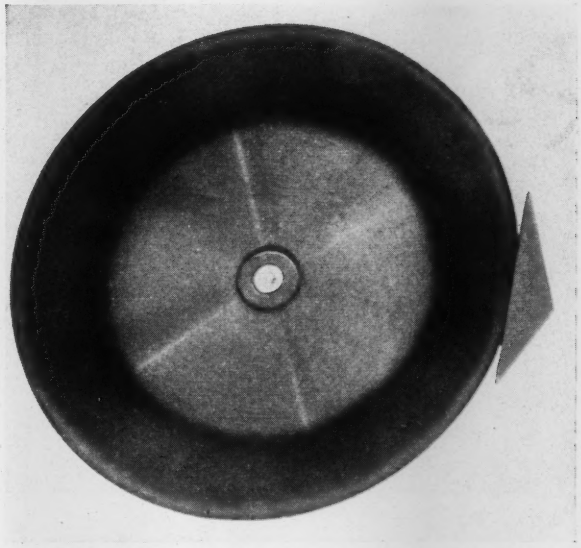


Fig. 4 Rubber skiving knives wore so rapidly that they had to be resharpened after every shift. By Flame-Plating one side of the blade with tungsten carbide, the expected service life was increased as much as 30 times.

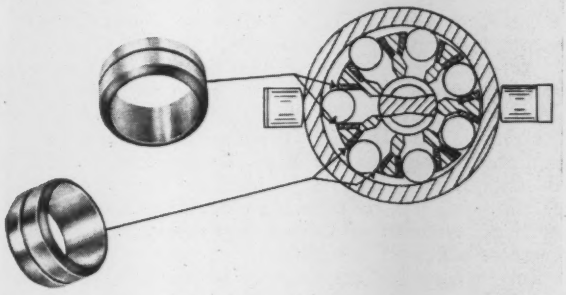


Fig. 5 These ball pistons in a hydraulic pump ride in Flame-Plated bushings. The tungsten-carbide coated steel bushings are extremely resistant to wear and, in addition, have the same coefficient of thermal expansion as the steel balls and cylinder block—a combination of qualities which make the design of this pump practicable.

and are hurled at 9000 fps at the workpiece. As blast after blast hits the surface of the part, the particles build up and fuse together until the desired thickness is obtained.

Although the temperature inside the gun barrel reaches 6000 F, the temperature of the workpiece seldom exceeds 400 F even when metals with extremely high melting points, such as tungsten carbide, are being deposited. This means that precision and semiprecision parts and tools can be Flame-Plated without risking changes in metallurgical properties or physical dimensions.

After Flame-Plating, the surface of the workpiece looks and feels like fine emery paper. The coating is about 125 microinches rms, measured by the Brush Analyzer.

The Flame-Plated part may be used in this condition or finished to various degrees of smoothness by standard carbide-finishing methods. By grinding and lapping, the coating can be finished to less than 1 microinch rms.

Automation

WHAT is automation? What will it mean to you and me in our daily lives? What will be its effect on our economy?

An attempt to answer the foregoing questions was made by Robert T. Sheen, president, Milton Roy Company, Philadelphia, Pa., during the Instrument-Automation Conference and Exhibit held in Los Angeles, Calif., Sept. 12 to 16, 1955, by the Instrument Society of America. The ASME Instruments and Regulators Division contributed two technical sessions and a dinner meeting to the program.

Fig. 6 Part of the 350 exhibits and 14,000 visitors at the ISA 10th Annual-Instrument-Automation Conference and Exhibit at the Shrine Auditorium, Los Angeles, Calif., September 12–16, 1955

According to Mr. Sheen, who was elected 1956 president of ISA, automation itself is not new—it is just more technical progress. It is art of taking work out of work, creating more and better jobs, and raising our level of living step by step with each improvement. Forgetting the technicalities, he said, automation is simply the process of making our industrial and business operations more automatic. It is an evolutionary process—not a second industrial revolution.

Automation has been applied to machine tools, material-handling equipment, inspection and assembly of components, and to combinations of these functions. Automatic calculators, typewriters, and data-handling equipment are areas of application. The process industries, notably chemical manufacturing and petroleum refining, could never have advanced to their present high efficiency without automation and automation is perhaps furthest advanced in this field.

Instruments are the tools of automation, Mr. Sheen pointed out. For example, a thermometer is an instrument used to measure temperature. A thermostat is a control based on the measurement of temperature used to control temperature—automatically.

Statistics actually reveal that of the total work force in 1935, 17 per cent was engaged in manufacturing. In 1953, despite the tremendous increase in plant instrumentation that has taken place in the period of 1935 to 1953, the percentage of total working force engaged in manufacturing in the later year increased to 25 per cent. In 1964, Mr. Sheen predicted, one of the greatest shortages in our country may be in manpower—in the labor force. Conservative estimates indicate that 184,000,000 Americans will want 40 per cent more goods than we consume today, yet the total work force to produce the goods will increase less than 13 per cent. Instrumentation and automation hold promise as to the most practical and desirable solutions to this anticipated labor shortage.

If our standard of living is to increase at its present rate, he continued, machines will have to be put to work where machines now do not exist. New, more versatile equipment will have to be created and built. This is not the only justification for control instruments and automation. We, the customers for industry, Mr. Sheen said, always look for better quality in the products we buy. We want this quality at the lowest possible price. In the face of these buying demands and in the light of the keen competition that exists between manufacturers for the market, any company must consider automation or fall by the wayside. Management must recognize that automation embraces all functions of the business and not just the techniques of manufacturing.

An automation program is a step-by-step analysis of the company's products from the financial, marketing, and engineering viewpoint which results in simplification and standardization. Labor has nothing to fear from automation, any more than it had to fear from technical progress labeled "technocracy" about 20 years ago. Far from destroying jobs, new jobs are created and workers are upgraded from dull, repetitive jobs to tasks worthy of human judgment and skills. With higher productivity per worker, the standard of living of labor will continue to increase. The ultimate function of automation, if it could be achieved, would be the constant improvement of all manufacturing operations until automatic production moved throughout the plant through one uninterrupted flow. This would be the so-called "push-button" factory, according to Mr. Sheen. Such a fully automatic factory has moved a little nearer being possible from the purely technical standpoint by recent developments and automation. The manufacturers of instruments and controls for this automatic machine will employ many of the workers displaced by the machine itself.

Finally, the customer of industry is most unpredictable. He has changing ideas on what is desired in the market. The frequent changes in clothing styles, the models of automobiles, give ample evidence to the constant rebuilding and redesign of machines and tools to replace obsolescent and outmoded equipment. The one way we can satisfy our boss—the buying public, Mr. Sheen stated, is by giving ever-increasing value and automation offers us the means for doing just that. It would have been possible for anyone to expect that the dial telephone was going to eliminate operators and cut telephone equipment. Just the opposite has happened, because the savings made possible by the installation of the dial telephone has brought on a great expansion in the use and

installation of phones so that in the last 10 years the number of telephone operators in this country has increased by 79 per cent.

It would be an oversimplification to believe that all this is possible without some temporary dislocations and without growth problems, Mr. Sheen pointed out. Again, these are not new either, but have been constantly with us. Labor and management both share an opportunity and a responsibility. Labor's opportunity is for a better standard of living and eventually a still shorter work week—its responsibility to promote understanding and co-operation with management to promote automation. Management's opportunity is for the production of more goods at lower costs, and at a satisfactory profit—its responsibility to minimize dislocations and to smoothly develop the acceptance and adoption of automation.

Industrial Television

INDUSTRIAL television has been put to use on the massive 35,000-ton forging press in the U. S. Air Force Heavy Press Plant at Aluminum Company of America's Cleveland, Ohio, works.

The press, which forges sections for modern military aircraft, is so powerful that an off-center load might unbalance its precise accuracy or even ruin the entire machine. The eye of TV is ruling out this hazard.

The TV camera is located in the press foundation. It keeps watch on a hydraulic mechanism which indicates eccentric loading. The receiver is installed on the portable operator's control station. If the televised picture indicates excessive off-center loading, the press operator is immediately warned and can take prompt action.

This novel safeguard is expected to help improve forging die design. Designers now can carefully chart causes of eccentric loading, enabling them to eliminate defects in future tools.

The 35,000-ton press and a 50,000-ton mate in the Alcoa-operated plant forge aircraft structural components

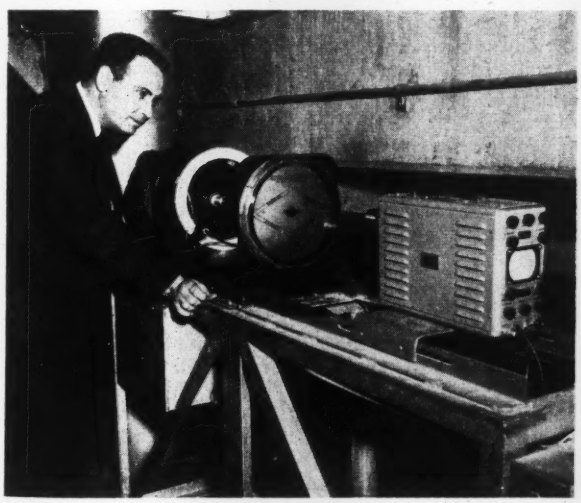


Fig. 7 The TV camera is located in the foundation of the press focused on the diamond gage. A picture of gage is shown on the receiver at the operator's control station.

Fig. 8 The TV receiver is located in the portable control station for the 35,000-ton press shown here. The press is installed in the USAF heavy-press plant at Aloca's Cleveland works.

by forcing aluminum alloy into shapes machined into sets of steel dies. The dies are attached to the upper and lower platens of the presses.

When the big squeeze is made to produce a part, the complicated shape of that forging may cause eccentric loading of the upper and lower platens. Compensation has been allowed for a limited amount of eccentricity. The degree of deflection must be measured by the stretching of huge tie rods, which hold the press within safe operating limits. Such distortion is reflected in the four hydraulic cylinders at each corner of the press. Engineers of United Engineering and Foundry Company, the press builders, cleverly attached small hydraulic lines to each cylinder. The small lines are connected to the mechanism viewed by the TV camera. This mechanism duplicates in miniature the observed differences.

When the press is centrally loaded a beam of light is focused in the center of a diamond-shaped gage viewed by the camera. If off-center loading occurs the beam moves from the center toward a border of the diamond, disclosing the location of the load center. Noting this movement, the press operator can prevent damage to the machine by taking corrective action. Should he fail to act quickly enough, the light touching the boundary of the diamond shape automatically takes the control from the operator, stopping all movement before the press can be damaged.

Higher Voltages Needed

THE rapid growth of electric-utility loads in the next 20 to 25 years is creating an "urgent need" for increased capacity for power transmission, according to Philip Sporn, Hon. Mem. ASME, president of the American Gas and Electric Company.

This forecast of the future of the electric industry by Mr. Sporn appears in an article "Recent and Past Progress in Power Transmission," in the October, 1955, issue of *Electrical Engineering*.

"In the light of the rate of growth of utility loads, and

the coming quadrupling of these loads over the next 20 to 25 years and the increase in the size of generating units being developed to meet the growth, there is an urgent need for utilities to plan for greatly increased capacity for power transmissions," Mr. Sporn observed at the conclusion of his review.

"How well 330 kv can meet this future challenge may be judged by considering the capability of a typical 135-mile line. Assuming eventual operation, after conductor aging, at 345 kv, loadings of 500 megawatts on one circuit or 1000 mw on a double-circuit line are feasible. In the short period of service that 330 kv has had on American Gas and Electric and Ohio Valley Electric Corporation systems, integrated loadings of 350 mw per circuit have actually taken place. And if a twin-conductor, double-circuit design should be adopted —an attractive possibility from the standpoint of resistance to conductor "dancing" and from the standpoint of radio-interference characteristics—these capabilities would be increased by at least 25 per cent to 625 and 1250 mw, respectively. This is more than eight times the capacity of existing double-circuit 132-kv lines.

"Such capabilities offer savings so high in the avoidance of future inadequacies of service and are, therefore, so important that the larger investment in high-voltage lines today can be an act of prudence. Taking such action will in the end serve best everyone concerned, including consumers and investors.

"It is of the utmost importance that we start to develop the higher-voltage networks now. But to start a new voltage on any power system involves initially large capital outlay. The engineers, charged with the responsibility of developing systems at minimum costs, naturally hesitate before taking such an ambitious step. They look to management to tell them to go ahead and do it; management on its part looks to the technicians; old voltages tend to be continued when new ones ought to be initiated.

"Now, however, we have reached a stage on many systems where the facts are so clear that management and technicians together should be able to discern that higher voltages are essential. This is a time, in short, when it is the job of management to give the engineers a policy that will enable the technicians to begin to plan, to build, and to operate the transmission that will be needed tomorrow and in the years ahead.

"If we do not make that start now, we risk foreclosing the route that eventually will be best from a technical and an economic standpoint; we risk finding ourselves overcrowded because of the proliferation of lines that lower voltages require, and with no space available for the much more effective users of space that high-voltage lines in fact are."

Giant Circuit Breakers

A TOTAL of 15 330-kv, 25 million-kva power circuit breakers will be installed at the Kyger Creek Plant of the Ohio Valley Electric Corporation at Cheshire, Ohio. The Kyger Creek Plant is one of two new generating stations built to supply power to the new AEC installations near Portsmouth, Ohio.

Built by Westinghouse Electric Corporation, the giant breakers embody the Watch-Case design that requires only about 50 per cent of the oil volume of a cylindrical tank having the same electrical clearances.

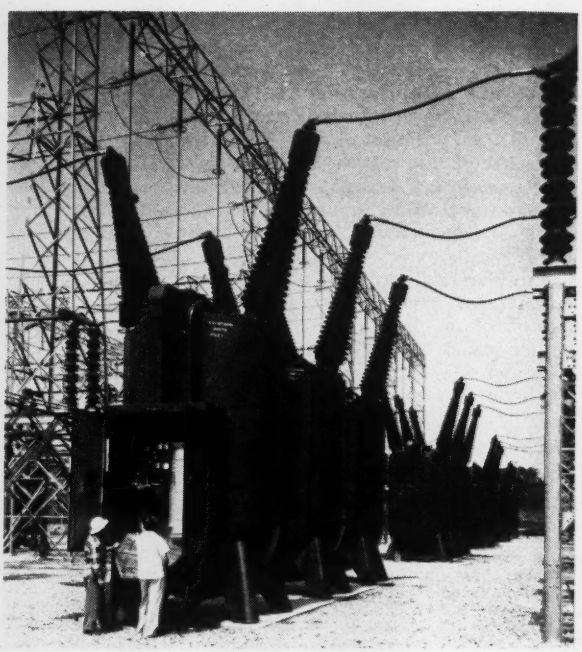


Fig. 9 View of five 330-kv, 25-million kva power circuit breakers installed at Kyger Creek Plant

The breakers have a continuous-current rating of 1600 amp, will interrupt in three cycles, and reclose in 15. They are approximately 28 ft high from foundation to bushing tip, 9 ft wide, and when filled with oil, weigh 183,000 lb.

Line dropping tests—that is, interruption of leading capacitive currents—have been completed, switching lines ranging in length from 34 to 185 miles. A total of 103 three-phase (309 single-phase) interruptions were made, the breakers performing without a single restrike or re-ignition.

Each breaker pole contains two interrupting assemblies, each having four breaks. Voltage-grading resistors and capacitors in parallel to the interrupting assemblies equalize voltages across each break during interruption so that each break carries its proportionate burden.

As many as 15 conventional bushing-type current transformers are used per breaker. Standard potential devices also are used.

For conveniences, special scaffolding, winches, etc., are provided to facilitate handling during erection and maintenance.

345-Kv Transformer

THE first 345-kv transformer manufactured in the United States passed all tests at the Allis-Chalmers Manufacturing Company plant in West Allis. The autotransformer, the first of six, will be installed in one of two 600,000-kva banks, believed to be the largest in the world.

In addition to the steep wave and standard ASA impulse tests, the unit received the new switching surge tests recently introduced by the company.

The autotransformer is a single-phase unit rated

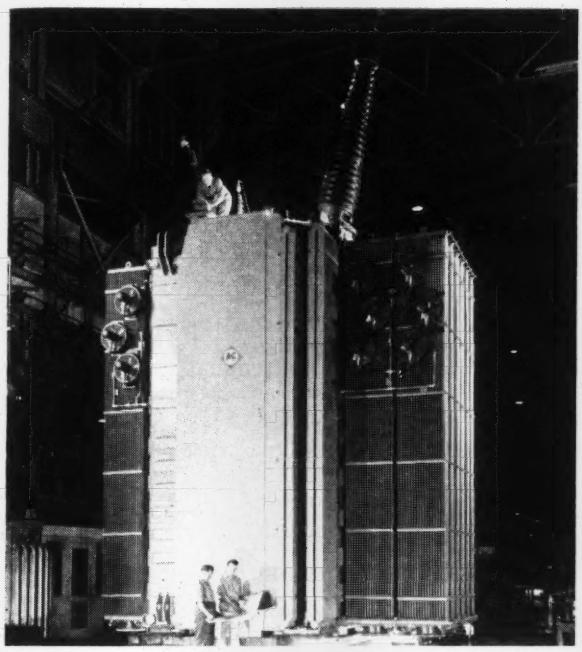


Fig. 10 First 345-kv transformer to be manufactured in the United States

120,000/160,000/200,000 kva, class OA/FA/FA, high voltage 345 kv, low voltage 230 kv. The unit weighs 394,000 lb complete and total height is $36\frac{1}{2}$ ft.

Three such transformers will be installed at each end of the new 345-kv transmission line from the McNary Substation, Umatilla, Ore., to the Ross Substation, Ampere, Wash.

Technical-Institute Survey

A REPORT summarizing the results of the 11th Annual Survey of Technical Institutes, which was made in January, 1955, has been prepared by Leo F. Smith, Dean of Instruction, Rochester Institute of Technology, and appears in *Technical Education News*, July-August, 1955. All institutions were asked to report enrollments as of January 2, 1955. The present survey includes enrollments for 69 schools in the United States, seven more than the number reporting a year ago. In addition, the enrollments from seven Canadian schools are included.

The survey reveals that in the 69 institutions reporting, a total of 26,766 full-time students were enrolled. This represents an increase of 24.3 per cent over the 21,527 students reported one year ago. In addition, 33,981 part-time students were reported this year, an increase of 15.5 per cent over the 29,410 reported last year. The grand total of 60,747 is an increase of 19.3 per cent as compared with 50,937 reported for 1953–1954. Enrollment in the Canadian schools is not included in these comparisons.

State and Municipal Institutes

An enrollment of 11,255 regular day students in 22 institutes was reported, as compared with 9903 in 19 such schools last year. The part-time enrollment this year is 10,451, as compared with 7913 one year ago.

Privately Endowed Technical Institutes

An enrollment of 4624 regular day students was reported by 12 schools, as compared with 2780 in 11 institutes one year ago. The part-time enrollment of 8503 students this year compares with 7798 reported one year ago.

The Milwaukee School of Engineering has altered its corporate structure and is listed with the privately endowed schools for the first time.

Extension Divisions of Colleges and Universities

A regular day enrollment of 4608 was reported in the extension divisions of 14 colleges and universities, as compared with 2993 in 11 of these schools last year. This year's part-time enrollment of 11,319 students compares with 9774 reported last year.

This year the enrollments from the Ward School of Electronics, a Division of Hillyer College in Hartford, Conn., and from the Vocational-Technical Institute of Southern Illinois University are reported for the first time. The Ward School offers work in industrial electronics and instrumentation.

The Vocational-Technical Institute of Southern Illinois University is located ten miles east of the regular campus, and curriculums are offered in the fields of architectural, automotive, radio and TV, drafting and machine design, welding, and machine-tool technology.

Proprietary Technical Institutes

A regular day enrollment of 6153 students in 19 schools was reported, which compares with 5800 reported by the same number of schools one year ago. The part-time enrollment this year is 2800 compared with 3421 last year.

Cal-Aero Technical Institute, which has participated in these annual surveys since their inception, has discontinued operations.

YMCA Schools

A day enrollment of 126 students in two YMCA schools reporting this year, compares with 51 reported by the same schools last year. The part-time enrollment this year was 908 as compared with 504 one year ago.

Canadian Schools

The day enrollment for the seven Canadian schools reporting is 2648 students. Last year six schools reported 2183. The part-time enrollment is 8003, as compared with 4817 last year.

Summary and Conclusions

As a result of this survey the following general conclusions may be drawn:

1 The day enrollments have increased significantly this year (24.3 per cent), as have the part-time enrollments (15.5 per cent). The total enrollments are also up significantly (19.3 per cent). Although 69 schools reported as compared with 62 one year ago, the enrollments would still be up without the additional seven schools.

2 Two new institutes, operating as divisions of colleges and universities, reported this year for the first time—Ward School of Electronics of Hillyer College, and

the Vocational-Technical Institute of Southern Illinois University.

3 The New York City Community College of Applied Arts and Sciences in Brooklyn reported the largest day enrollment with 2543 students. The largest part-time enrollment, 5458 students, was reported by the Ryerson Institute of Technology. Ryerson Institute had the largest total enrollment with 7046 students. The Penn State Technical Institutes had 5892; Rochester Institute of Technology, 5059; the Brooklyn Institute, 4402; and the Long Island Agricultural and Technical Institute at Farmingdale, 4115.

Industrial Boiler Trends

THE following pronounced trends were evident in the purchasing of industrial boilers during 1955: First, development of standardized designs was continued because of the widespread industrial acceptance of boilers which could be ordered, in a sense, "off the shelf and from a catalog." Second, industrial power plants reaped benefits from the central-station industry by adaptations of techniques and designs developed for large utility steam-generating units to the special needs of industrial steam generation. Third was the increased interest in high-temperature water for heating and processing needs.

To show its awareness of these trends in industrial purchasing, Combustion Engineering, Inc., of New York, N. Y., has introduced several new or improved designs to meet the special needs of industry for standardized units. For example, the C-E package boiler, Type VP, with demonstrated records of economical operation, was given a new look both outside and inside. The exterior is more compact and streamlined, the duct work has been simplified, and the controls and fan are not an integral part of the boiler front. Use of $2^1/_2$-in-diam tubes in place of 2-in. tubes permits closer spacing of the tube surfaces in the main boiler tank and is said to result in up to 25 per cent more heating surface per tube. It increases mass flow rates, assures more efficient heat transfer, and provides increased steam output per unit of volume occupied by the boiler.

A completely new boiler, the VU-55, which is a development of Combustion's long-established vertical unit design, is now being offered for steam capacities in the 50,000 to 120,000-lb per hr range. This unit, which is available in five sizes for steam conditions from 250 to 500 psig and temperatures up to 750 F, incorporates many features from large utility installations. Tangential firing is one of the innovations introduced for the

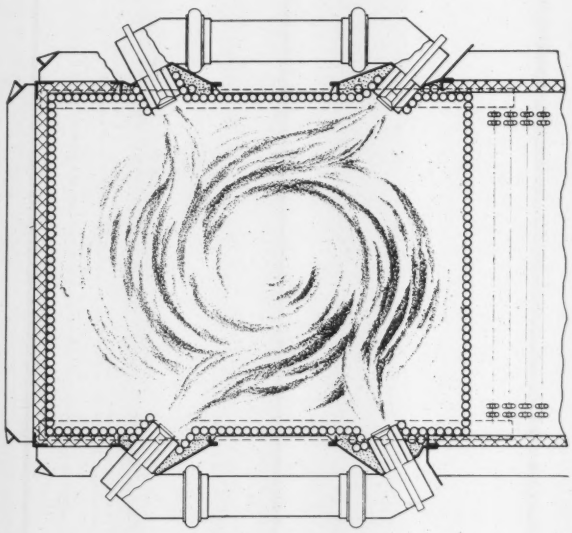


Fig. 12 Plan view of VU-55 furnace showing arrangement of burners for tangential firing. Flame streams from the four burners impinge upon one another at high velocity, creating a turbulence unattainable by any other method of firing. The result is rapid and complete combustion. As the gases spiral upward, they sweep all furnace heating surfaces, assuring a high rate of heat absorption.

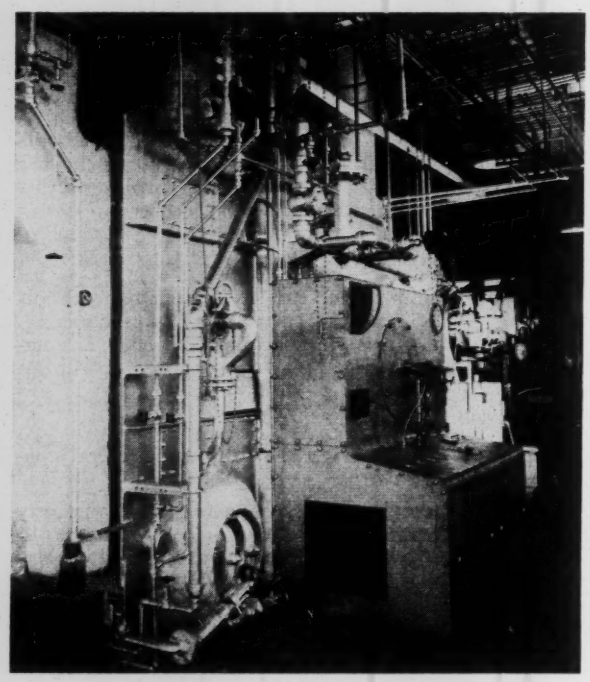


Fig. 11 C-E Type VP Package boiler shown in operation in a chemical plant

first time in a boiler of this capacity range. The use of a double-wall pressurized casing assures lifetime tightness with minimum heat loss, while pressure firing permits elimination of an induced-draft fan with its attendant operating and maintenance costs. Other features of the VU-55 include a 60-in. steam drum with C-E internals to insure high steam quality, the use of tangent tubes, and the elimination of outside downcomer tubes which contributes to the streamlined exterior of the boiler. The unit may be pressure-fired by either oil or gas and equipped with a tubular or regenerative air preheater.

Industrial acceptance of high-temperature water for heating and processing needs was one of the outstanding developments of 1955. The C-E LaMont controlled-circulation hot-water boiler is the result of combining experience in both the utility and industrial power fields. It is available in sizes from 15 to 200-million Btu per hr,

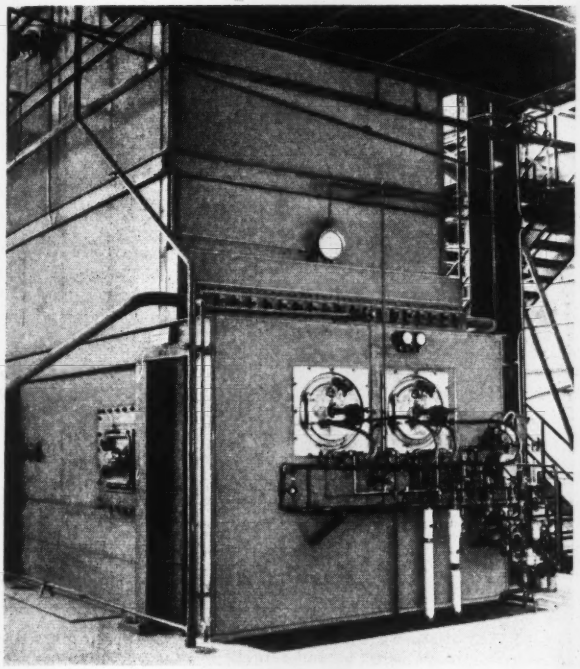


Fig. 13 C-E LaMont controlled-circulation hot-water boiler installed at an air base

or more, with pressures up to 300 psig and temperatures to about 425 F. Firing may be by oil, gas, or C-E spreader stoker. Among the advantages of the C-E hot-water boiler are these:

1 Complete control over high-temperature water movement in both system and boiler.

2 Low-pressure loss is inherent so no separate boiler pump is required.

3 Pressurized operation with oil or gas means no induced-draft fan.

4 It is of the single-pass design having no baffles and a low-draft loss. The result is a cleaner boiler.

5 More efficient heating surface can be arranged because of positive controlled circulation.

6 The setting is steel-enclosed, and there are few headers, all of which are accessible. Oil, gas, or coal may be burned.

There are hundreds of high-temperature water installations operating abroad and a rapidly growing number in the U. S. A. The use of high-temperature water for processing needs is increasing and as the many engineering possibilities are explored, industrial and large institutional plants will find new applications that will make high-temperature water an important part of the quest for a more efficient solution to heating and process-steam needs in industrial plants.

Municipal Gas-Turbine Plant

AMERICA's first municipal gas-turbine power plant has been put into operation by the City of Larned, Kan. Marking a further important step in the use of gas turbines for electric-power generation, the 1250-kw unit was supplied by Westinghouse Electric Corporation's South Philadelphia, Pa., plant.

Completely self-contained, the gas turbine requires no boiler or other external heat source, since it burns fuel and converts the heat energy into electricity all in a single assembly. The turbine operates at 8750 rpm, and is connected to the 1563-kva, 1200-rpm generator by a single-reduction, double-helical gear.

For full operation, 28,000 cfm of air is drawn in by the axial air compressor and compressed to 53 psig. Fuel is admitted and burned in the combustion chambers to heat the compressed air to 1250 F. This hot gas expands through the gas turbine, which converts the heat energy into mechanical energy to drive both the axial air compressor and electric generator. The gases are then exhausted to atmosphere at 780 F.

The unit is the simple, open-cycle type and is but 35 ft long, 6 ft wide, 6 ft high, and weighs only 41,000 lb.

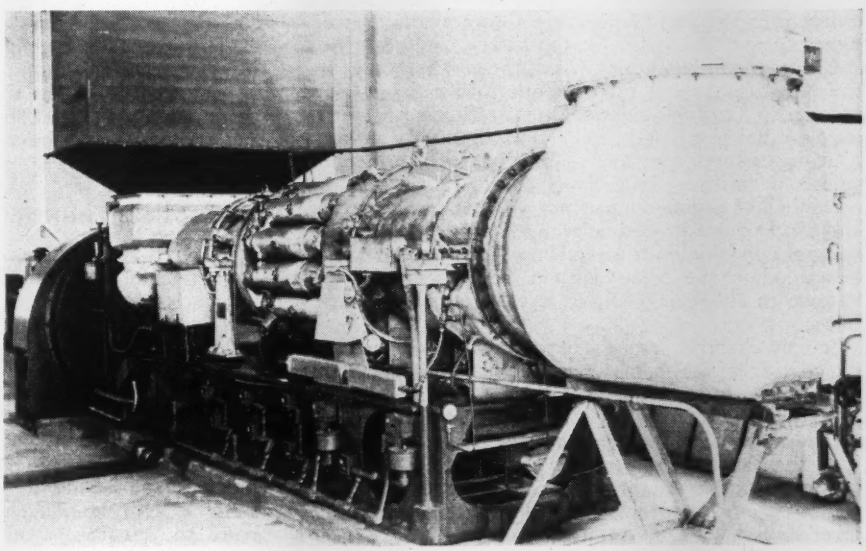


Fig. 14 Interior view of City of Larned's 1250-kw gas-turbine power-plant installation

It is equipped with a dual-fuel system which allows the burning of either natural gas or distillate oil. Either fuel can be used for start-up, and a fuel changeover, under load, can be made by manual operation of switches on the control board. This marks the first installation in America of a gas turbine for electric-power generation which can change over, under load, from gaseous to liquid fuel and back again with no effect upon load.

Two "oil-to-air" radiator-type coolers are used to cool the lubricating oil for the gas-turbine power plant. One cooler is used for normal operation; the other is available as a stand-by. A selector valve permits transfer from one lubricating-oil cooler to the other. Cooling air is supplied by motor-driven axiflow fans automatically controlled by a thermostatic switch in the lubricating-oil piping.

The gas turbine is controlled by a combination of mechanical, hydraulic, and electrical components. Protection against overspeed is provided by an auto governor. The automatic and semiautomatic controls, instruments, gages, and switches for starting, operating, and stopping the gas-turbine power plant are mounted on a fabricated-steel control panel.

The gas turbine is said to be less expensive over-all and requires less space than a comparable engine plant or steam-electric unit. It will need relatively little operating and maintenance labor. The 1250-kw gas-turbine power plant can operate with no cooling water and is, therefore, highly flexible with regard to location.

Instantaneous Car Heater

A NEW automobile heating system which is completely independent of the car's engine or coolant, delivers fresh, heated air from outside almost instantly after it is turned on, and is completely automatic in maintaining a preselected temperature in the car without attention from the driver regardless of speed or outside temperatures, has been announced by the South Wind Division of Stewart-Warner Corporation.

The heater, which will be available for use as optional factory equipment on two popular 1956 model cars, is said to be four times faster, in delivery of heat, and 60 per cent hotter than any heater heretofore available to car owners.

Unlike the former South Wind, the new system utilizes the heat-distribution system built into cars by manufacturers. Located under the hood, the new heater has its own fuel pump and combustion air supply as well as continuous spark ignition. Thus it is not dependent on engine operation. It delivers heat almost instantly, regardless of engine temperature or outside temperature, and can be turned up to deliver 180-F heat for quick deicing of windshields or for quick warm-up of a car which has stood in the cold. Heated fresh air in sufficient volume to change the air in the car is delivered every 60 sec.

In cold-chamber tests the new system has cleared a $^1/_2$-in. coating of ice from a windshield in less than three minutes, with outside temperature of −30 F.

A thermostat controlled from the instrument panel provides automatic temperature control of air delivered into the car, through a range of 65 to 180 F. The thermostat actuates the heater without attention from the driver, and maintains at all times the selected comfort level desired.

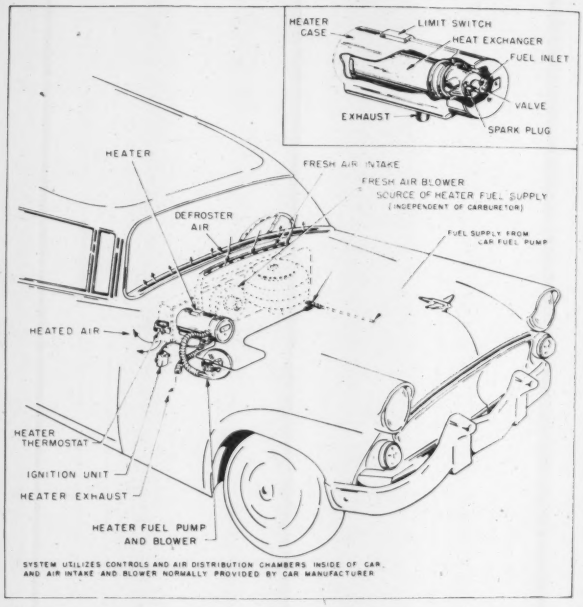


Fig. 15 Installation example of South Wind car-heating system in a car equipped with a cowl ventilator of fixed opening. In the sketch, air is drawn from a plenum chamber below the air scoop and forced through the heater by means of a blower. The air is passed over the heat exchanger and into the distribution chamber within the car where it is used either for car heating or for defrosting. There is a separately mounted assembly consisting of a motor, combustion air blower, and fuel pump. There is also an ignition unit consisting of a vibrator, condenser, and high-tension coil. The thermostat is mounted in the distribution plenum chamber inside the car and is controlled by a knob or lever on the instrument panel.

The quick-heat feature is particularly desirable in modern cars, all of which now use overhead valve, high-compression engines. The slow warm-up characteristics of these higher-compression engines, and their higher-operating efficiencies, mean less heat rejected to the engine coolant. Thus less heat is available for passenger-comfort use; accordingly, heater warm-up is slow and unsatisfactory, particularly for modern stop-and-go, short-distance driving. By not "robbing" the engine of heat needed to maintain efficient engine operation, the new system permits both maximum engine-fuel economy and maximum engine-service interval.

Controlled Thermonuclear Program

THE U. S. Atomic Energy Commission is carrying on its major research effort in controlled thermonuclear reactions at Princeton University and at AEC laboratories operated by the University of California at Los Alamos, N. Mex., and Livermore, Calif., according to Lewis L. Strauss, chairman of AEC. In addition, there are projects at Oak Ridge, Tenn., and New York University. The over-all research program is known as Project Sherwood.

This long-range program, to which Mr. Strauss referred during the recent "Atoms for Peace" Conference in Geneva, has been under way for years and is directed toward the possibility of controlling the release of the

great amounts of energy from reactions involving the fusion of light nuclei.

Mr. Strauss said:

"It cannot be stressed too strongly that, based on what we know, we are far from a solution of the problems of the controlled fusion reaction.

"Our work is in the research stage and many years of intensive effort may be required before the first prototype of an operating thermonuclear machine may be developed.

"We have every intention of attacking as vigorously as possible the remaining problems."

This process of energy release is believed to be similar to that which constitutes the source of the sun's energy. The *controlled* release of this energy may offer significant potentialities for peacetime application, and the present research program within the AEC was instituted in the hope of developing these potentialities.

In essence, the problem is that of heating an appropriate nuclear material (such as deuterium) to temperatures of several hundred million degrees and of confining it somehow at that temperature for a sufficiently long period of time to allow an appreciable portion of the nuclei to fuse together, with consequent release of energy in the form of energetic neutrons and charged particles. This process could constitute a great new source of energy.

The possibility of tapping this source of energy has long been intriguing to science. Some of the problems to be overcome are of extreme difficulty. The project began in 1951 and the level of the research effort has been rapidly expanded since. There is a wide variety of problems of a theoretical, experimental, and technical nature, the solution of which will require the talents of highly qualified people in many fields of science and engineering.

Princeton University

Prof. Lyman Spitzer, Jr., who has been directing the work at Princeton, pointed out that "by far the greatest reserve of stored energy on earth is locked up in the nuclei of the hydrogen atoms present in the oceans. Deep inside the sun and stars hydrogen nuclei combine to form helium nuclei, releasing vast energies. This combination, or fusion, of light nuclei is called "thermonuclear burning." The titanic energies released by thermonuclear burning have been unleashed in the hydrogen bomb.

"Thermonuclear burning occurs most readily with deuterium, a heavy isotope of hydrogen. Although only one deuterium nucleus is present in water for every 6400 nuclei of ordinary hydrogen, the total amounts of deuterium available in the oceans is enormous. If the energy stored in these nuclei could be released in a controlled manner and used for generation of electrical power, a virtually inexhaustible supply of power would be available to mankind. Conservatively estimated, the deuterium in the ocean's waters is sufficient to provide many times the present rate of world-energy consumption for more than a billion years.

"Thermonuclear burning occurs only at enormous temperatures, above a hundred million degrees Fahrenheit. Such temperatures have hitherto existed only at the centers of very hot stars or during the explosion of an atomic bomb. To convert the inexhaustible supply of energy in the earth's deuterium into useful power, we must achieve such temperatures in a gas confined within walls that remain relatively cool. We must control the thermonuclear reaction when it occurs. We must extract the energy released and use it to generate electricity. The scientific and technical difficulties to be surmounted are obviously formidable.

"The Forrestal Research Center of Princeton University has been carrying out a classified program of research on the problems of releasing thermonuclear energy in a controlled way. We are fortunate in having assembled a team of very able young scientists and engineers who are working enthusiastically on this program. However, commercial generation of electrical power with thermonuclear energy cannot be expected for a very considerable number of years."

Los Alamos Scientific Laboratory

Norris E. Bradbury, director of the Los Alamos Scientific Laboratory, said that technically it is not possible to add much to what already has been said. The following two points might be mentioned; the long-term nature of the project must be emphasized. Second, since hydrogen bombs exist, the study of the controlled release of thermonuclear energy might be associated in the public mind with such hazards as tremendous explosions that can be restrained only with difficulty. No such hazards seem to be present. The main problem seems likely to be that of getting enough thermonuclear energy back from the material, heated to more than one hundred million degrees, to repay the power used to achieved and maintain this high temperature.

Anti-Proton—New Atomic Particle

THE discovery of a new atomic particle, the anti-proton, which may inaugurate a new era in nuclear research, was announced recently by the Radiation Laboratory of the University of California and the Atomic Energy Commission.

The anti-proton (sometimes called the negative proton) a nuclear ghost which has haunted the world's physicists for a generation, was created from energy generated in the great Berkeley bevatron, the most powerful atom-smasher in the world.

Discovery of the anti-proton fulfills one of the important purposes for which the AEC spent some $9,500,000 in bevatron construction costs plus annual research budgets, said Dr. Ernest O. Lawrence, inventor of the cyclotron, Nobel laureate, and Director of the Radiation Laboratory. The Radiation Laboratory has conducted one of the major fundamental research programs for the AEC since that Government agency was established.

Dr. Lawrence, who made the announcement, spoke within a month of the 25th anniversary of his first presentation of the cyclotron idea, at a meeting of the National Academy of Sciences in Berkeley, Calif.

The scientist said the discovery of the anti-proton is a major fundamental achievement in physics and added that it is not possible now to evaluate it fully.

"Recalling that at the beginning of the past quarter century the discovery of the positive electron set off the remarkable developments of nuclear physics that followed," Dr. Lawrence said, "one cannot help but wonder whether the discovery of the anti-proton . . . likewise is a milestone on the road to a whole new realm of discover-

ies in high-energy physics that are coming in the days or years ahead."

There is no known "practical" application of the anti-proton discovery. There is no known way, for example, in which the anti-proton could be used to generate energy as the neutron does in fission. The anti-proton is a heavy particle of the same mass but of opposite charge from the proton, which is one of the fundamental particles found in all atomic nuclei.

The existence of anti-protons has been a basic tenet of generally accepted atomic theory for a quarter of a century. Despite continuing experiments with cosmic rays, however, the particle had not been detected.

The discovery does not modify the model of the atomic nucleus, according to the discoverers. Rather, it reinforces and solidifies current theory. This elimination of uncertainty about one of the cornerstones of nuclear theory is one of the discovery's most valuable features.

The long lapse between prediction of the anti-proton and its discovery had led many experimental physicists to doubt its existence, although generally no such doubt existed among the theoretical physicists.

Efforts to devise theories to "get along" without the anti-proton had been made. With such questions now erased, the anti-proton may provide a wedge for a deeper probe of the nucleus.

Berkeley scientists pointed out that the anti-proton does not exist in the atomic nucleus, which is composed of only protons and neutrons. Anti-protons are born and "live" only outside the nucleus following some high-energy nuclear event similar to the collision resulting from bevatron bombardment. The main reason anti-protons have not been discovered before is that they occur only at high energy.

Until the bevatron was constructed nuclear bombardment of sufficient energy could not be made. The reaction is as follows: Protons are accelerated in the bevatron to 6.2 billion electron volts. These particles are directed at a target of copper inside the bevatron chamber. When the proton crashes into a neutron in one of the copper atoms the following come out of the collision: The two original particles (the proton projectile and the struck neutron); and a brand new set of heavy particles, a proton and an anti-proton. In the collision a part of the bombarding protein energy is converted into mass, according to Einstein's theory. The particles are expected to be found in cosmic rays but in low abundance.

The anti-proton is stable in a vacuum and does not disintegrate spontaneously. When, however, it comes into contact with a proton the two particles immediately decay into mesons and disappear. Essentially, the scientists demonstrated the anti-proton by devising selecting apparatus constituting a "maze" through which only anti-protons could pass. To date the particles have been observed only by radiation counters. Efforts are being made to obtain photographs of them in photo-emulsions.

Magnetic Refrigerator

A NEW-TYPE refrigerator that will maintain lower temperatures than any previous apparatus has been developed at Arthur D. Little, Inc., of Cambridge, Mass. The temperatures produced in this machine—approximately 500 deg colder than those of a domestic refrigerator—come to within a fraction of a degree of the coldest temperature that scientists believe can ever exist. The interior of the refrigerator would be even colder than the remote depths of outer space.

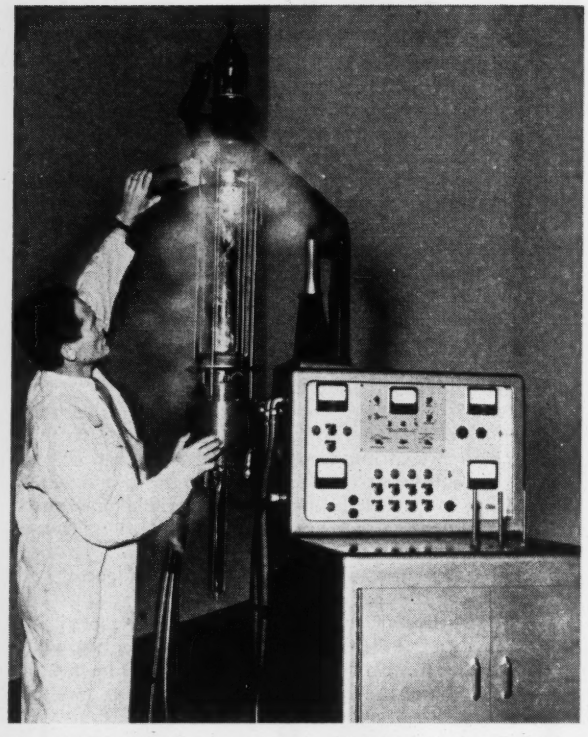


Fig. 16 Dr. Ivan Simon, research physicist at Arthur D. Little, Inc., prepares to operate a new-type refrigerator that will maintain lower temperatures than any previous apparatus. The temperature of the refrigerated space—a slender tube at the lower left—comes within a few tenths of a degree of absolute zero (—459.6 F).

Spokesmen for the company explain that the design represents a major departure from ordinary refrigerating systems. It is based on a cyclic principle of magnetic cooling originated by Drs. John G. Daunt and Clifford V. Heer of the Ohio State University.

There are no moving parts or flowing fluids in this cooling system. It uses, instead, a plastic capsule three inches long, containing a special chemical salt as the refrigerant. Operation of the refrigerator is controlled entirely by external magnetic fields.

The principle of magnetic cooling—the fact that certain materials will warm up when magnetized and cool when demagnetized—has been used for several years in a few cryogenic (low temperature) laboratories for achieving extremely low temperatures in the range of absolute zero (—459.6 F). This is the first apparatus, however, that has been able both to produce these extreme low temperatures and to maintain them for long periods of time. All previous equipment would immediately begin to warm up as soon as the low temperatures had been reached.

The ADL magnetic refrigerator is believed to represent the first commercial application of the phenomenon called "superconductivity." This is a change that certain metals undergo at very low temperatures in which they lose all resistance to an electric current.

At the same time, metals in the superconducting state act essentially as thermal insulators but conduct heat readily when not showing the superconducting effect. It is this thermal phenomenon of superconductors that is employed in the new ADL machine.

According to the company, the ADL magnetic refrigerator will enable scientists to carry out many new experiments aimed at getting a better understanding of the basic laws of matter. It was explained, for example, that many of the more subtle changes going on in atoms and molecules are difficult to measure at ordinary temperatures because these tiny bits of matter are constantly darting and dancing about. But, at extremely low temperatures near absolute zero, atoms and molecules become quiet and can be more easily studied.

The magnetic refrigerator will complement the work of another product of ADL's extensive experience with low-temperature equipment—the ADL Collins helium Cryostat, a machine for making liquid helium. The Cryostat is now used in more than 75 per cent of the nation's low-temperature laboratories. The magnetic refrigerator is now available as a companion to the Cryostat for exploring low-temperatures.

Seven Modern Engineering Wonders

THE American Society of Civil Engineers recently made public, at its headquarters in New York, N. Y., the projects that a special committee of eminent members, with the concurrence of the Board of Direction, has designated the Seven Modern Civil Engineering Wonders of the United States (see photos, pages 1090 and 1091). Presented alphabetically, with no other significance in their order, they are as follows:

Chicago Sewage Disposal System. Operated by the Sanitary District of Chicago, this project involved Herculean tasks. Chicago used to discharge its sewage into the Chicago River and Lake Michigan. Its water supply came from Lake Michigan. In a tremendous excavating job, the Chicago drainage Canal was dug. Sewage discharging into it passed via the Desplaines River, a tributary of the Illinois River, into the Mississippi River. Control gates were built at the mouth of the Chicago River, the flow of which was reversed. Toward achievement of a program of complete treatment of all sewage, great activated sludge plants were designed and constructed to produce an effluent safe to discharge into the canal. They included the West-Southwest treatment works, largest in the world. The quality of the effluent from these plants made it safe to reduce substantially the diversion of dilution water from Lake Michigan.

Colorado River Aqueduct. Created and maintained by the Metropolitan Water District of Southern California, the aqueduct serves 66 municipalities in 5 counties that have a total population of 6,000,000. Provision for continued growth of the area has been made by the Colorado River over a distance once unthinkable, part canal, part tunnel, part siphon, crossing miles of barren desert and mountains. Involved were 30,800,000 cu yd of excavation, 4,037,000 cu yd of concrete, 6,059,000 bbl of cement, and 116,000 tons of reinforcing and structural steel.

Empire State Building, New York City. Queen of skyscrapers, this is the tallest building man has constructed. The frame contains 57,000 tons of steel. Its 102 stories and a 222-ft multiple television tower reach a height of 1472 ft. In the precision of construction operations in the midst of exceedingly heavy traffic and in its completion a month ahead of schedule, the building represents what has been described as "a triumph of man's engineering genius." Its construction statistics include: 700,000,000 lb of steel, stone, wood, brick, aluminum, and other materials; building's weight of 365,000 tons was less than the weight of the excavated rock and dirt; 75 miles of water mains, 17,000,000 ft of telephone and telegraph wires and cables.

Grand Coulee Dam and Columbia River Basin Project. This U. S. Bureau of Reclamation irrigation marvel in the State of Washington, exemplifies the remarkable scope of constructive vision and planning of the modern civil engineer and the tremendous sources of power at his disposal. The project can provide irrigation water for 1,000,000 acres and has the world's largest hydroelectric power plant. The dam is 550 ft high. The project involved the placing of the largest single mass of concrete in the world, more than 10,000,000 cu yd. A single one of the dozen centrifugal pumps which lift water to the irrigated areas could take care of all the water needed by New York City. Not long ago this triumph would have been regarded as impossible. In its entirety it has no counterpart. It is of immense importance in the development of the Inland Empire and the nation's economy.

Hoover Dam (Arizona-Nevada). Another Bureau of Reclamation project, this is the world's highest dam, 726 ft. In mastery of mind over matter it set a new level of attainment. It may be described as a hybrid structure since it is both an arch and a gravity dam. Civil engineers had to solve the problem of the cooling and shrinking of the cast mass of concrete, which would take years by natural process. Danger of shrinkage cracks had to be avoided. Great dams are built in alternate blocks, the intervening blocks being poured after the first set has cooled. The cooling process at Hoover Dam was hastened by circulating cold water through a network of pipes laid on top of each 5-ft lift of concrete. Not only the highest concrete dam in the world, but its design and construction introduced many conceptions accepted for dams subsequently built.

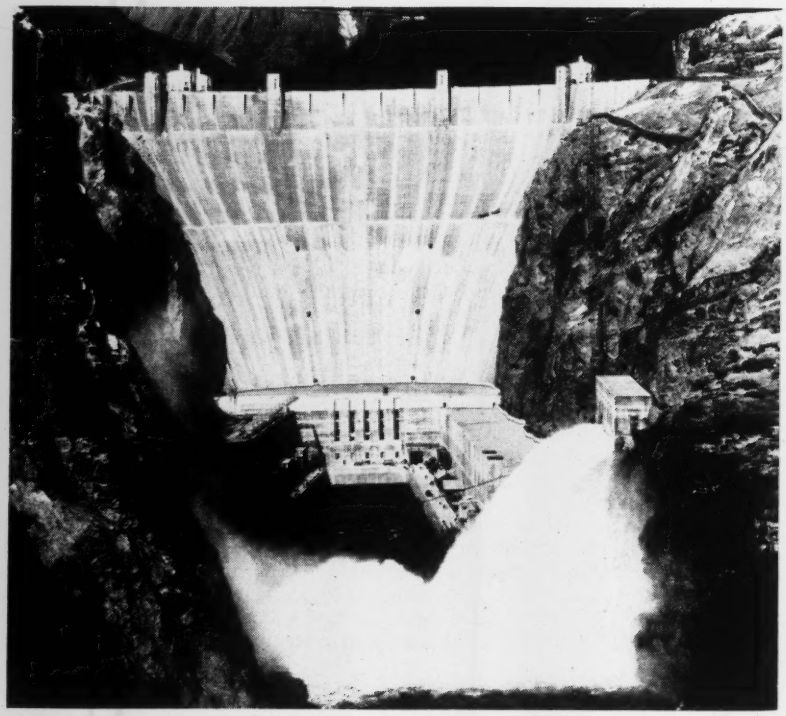
Panama Canal. Many claims to fame belong to the Canal, not the least of which is its great size. It lifts big vessels over the backbone of the Western continents from ocean to ocean through a series of huge locks. It has been of distinguished service to the entire world. When built it represented an entirely new set of developments—quantities of earthwork removed, size of machinery, control of communicable diseases. It was envisioned by early Spanish explorers centuries ago. The French tried to sever the Western continents and failed. The eventual successful execution was a triumph for mankind.

San Francisco-Oakland Bay Bridge. Total length of steel over water is about six miles. Between its twin suspension spans is a great anchorage pier, the most spectacular foundation job of modern times, involving the sinking of a gigantic caisson to a depth of 242 ft. This was done with the aid of unique dome-shaped dredging wells which permitted the use of compressed air to control the flotation of the huge units. A great tunnel was bored through Yerba Buena Island as a part of the project. It is the largest, though not the longest, tunnel in the world.

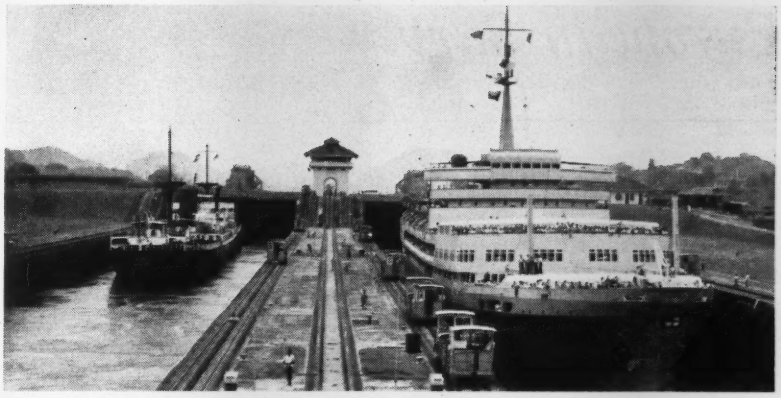
San Francisco-Oakland Bay Bridge—truly a wonder among many fine bridges

Seven Modern Engineering Wonders

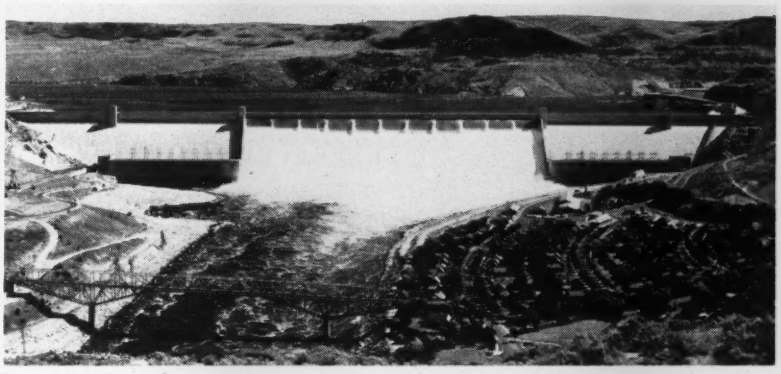
Empire State Building in New York—world's tallest building silhouetted against the sky in downtown Manhattan



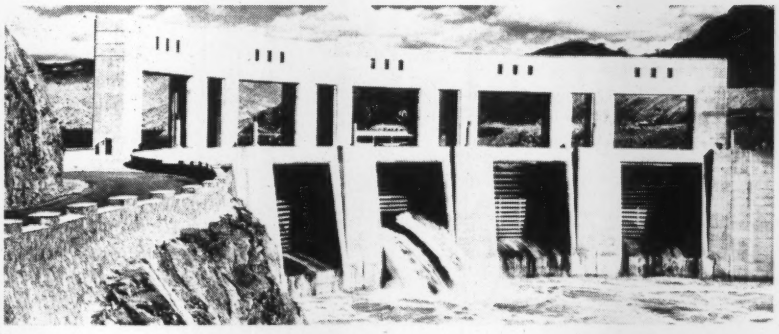
Hoover Dam—world's highest dam, is a combination arch and gravity structure



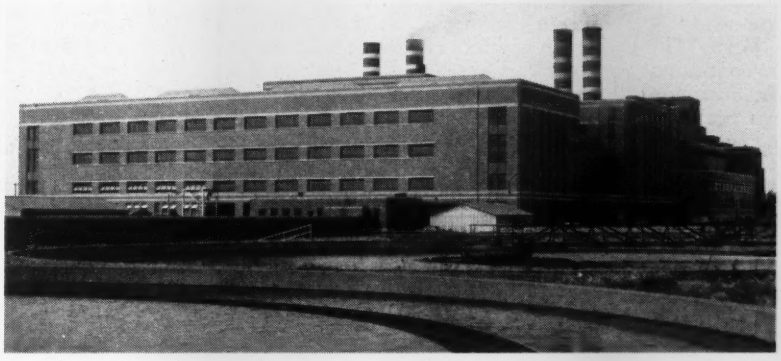
Panama Canal—linking two oceans—has greatly benefited trade and commerce



Grand Coulee Dam and Columbia River Basin Project—irrigation marvel



Colorado River Aqueduct—Parker Dam regulates the flow of the river and has formed a reservoir 55 miles long



Chicago's West-Southwest Plant—world's largest sewage-treatment plant

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

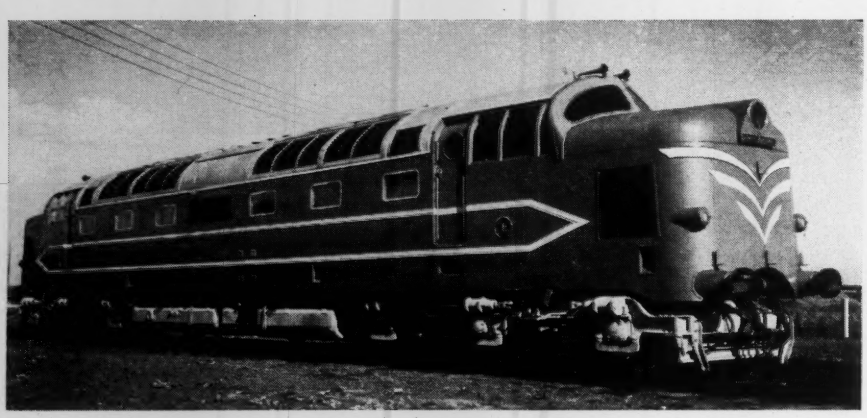


Fig 1 5300-hp diesel-electric locomotive for British Railways (English Electric Company Ltd.)

3300-Hp Diesel-Electric Locomotive

As was mentioned in the November "European Survey," British railways are committed, as a matter of policy, to the gradual supersession of steam locomotives by diesel and electric traction. For financial reasons, main-line electrification is likely to proceed slowly, but a start has been made already with the introduction of diesel-driven trains on branch lines, and now a further step has been taken toward diesel haulage of main-line passenger and freight trains.

Experimental running has begun with a 3300-hp diesel-electric unit, Fig. 1, which is claimed to be the most powerful single-unit locomotive of its kind in the world, and to have the best power-weight ratio—72 lb per hp—of any form of diesel locomotive. It has been constructed by the English Electric Company and is driven by two "Deltic" 18-cyl two-stroke engines, Fig. 2, made by D. Napier & Son, Limited, a member firm of the same industrial group. The length over the buffer beams is 64 ft, the width 8 ft $9\frac{1}{2}$ in., and the height above rail level 12 ft $10\frac{1}{2}$ in. The bogies have a wheelbase of 14 ft 4 in. and the distance between pivot centers is 44 ft. The maximum tractive effort is 60,000 lb and the continuous tractive effort 31,000 lb at 33 miles per hr. The maximum service speed is 90 mph (though the design permits of gearing to a higher speed if required) and the weight in running order is 106 long tons.

There is a traction motor on each of the six axles. The minimum curve that can be negotiated is 6 chains (396 ft) radius. The fuel capacity is 800 gal. As steam is used for train heating on the British main lines, a heating boiler is provided on the locomotive; it has an output of 2000 lb per hr of steam at 80 psi and is provided with a feed tank holding 600 gal, which can be filled by a pickup scoop from the track troughs. Air brakes are used on the locomotive itself, but vacuum-braking equipment is also carried, as the trains are fitted with vacuum brakes. There is a driving compartment at each end. The "Deltic" engine, which has been used for some time in motor torpedo boats, is so called because of its unusual cylinder arrangement; the three cylinders which form a group (each containing two opposed pistons) represent an inverted equilateral triangle in end elevation.

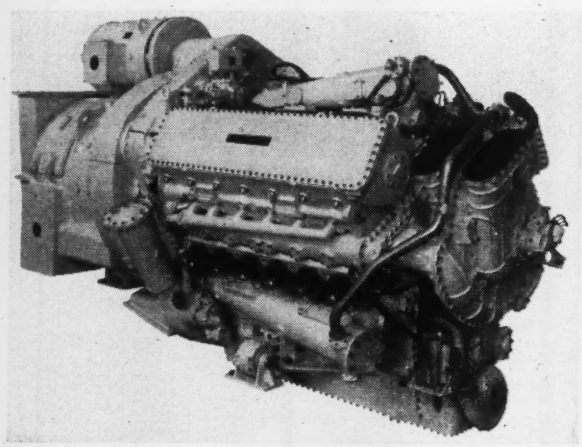


Fig. 2 1650-hp engine as used in English Electric Company's diesel-electric locomotive for British Railways. The Deltic 18-cyl opposed-piston water-cooled diesel engine operates on the two-stroke cycle. The cylinders are arranged in three banks of six, each bank containing a crankshaft, the cylinders forming in end view an inverted equilateral triangle—hence the name "Deltic."

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

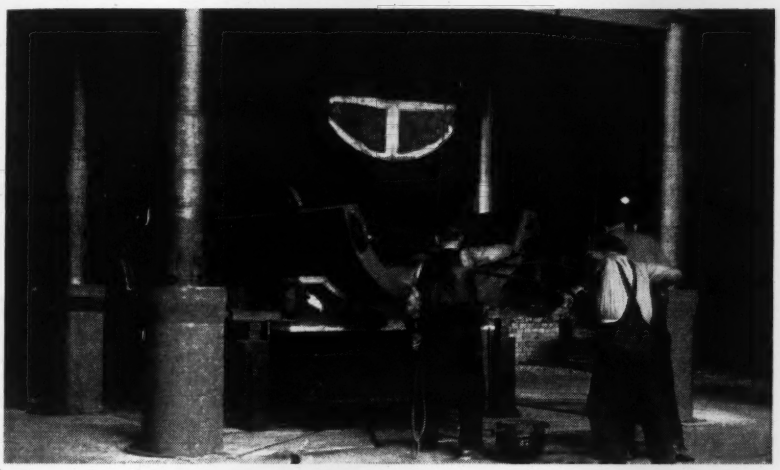


Fig. 3 View of new 2000-ton press showing upper bolster raised and lower die with workpiece in the operating position

2000-Ton Forging Press

FIELDING & Platt, Ltd., Gloucester, England, have recently supplied to the Renfrew, Scotland, works of Babcock & Wilcox, Ltd., a four-column 2000-ton hydraulic press for forging the ends of boiler drums, up to any size so far contemplated. It is of the moving-column type to minimize the necessary headroom, as it is installed in an existing forge, where a press of conventional type would have interfered with the travel of the overhead crane. See Fig. 3.

The lower die, instead of being raised on a ram, is secured to a fixed table at floor level and the upper die is carried on the upper bolster, which is attached to the main columns of the press. These columns pass through the table and are secured at their lower ends to a second heavy steel bolster, upon which the hydraulic cylinders act. The two outside rams exert a power of 1334 tons and the four inner rams 667 tons. The moving head has a stroke of 8 ft. The column centers are spaced 14 ft 6 in. from left to right and 10 ft 3 in. from front to back, which enables the press to take the heaviest plate rolled, up to a maximum width of 12 ft 6 in. It will also press drum ends from circular blanks 12 ft 6 in. diam and 7 in. thick. The maximum "daylight" is 11 ft 6 in. and the minimum 3 ft 6 in. The height above floor level is 18 ft 6 in.

For feeding in and withdrawing the work there is a sliding table operated by two hydraulic cylinders with a stroke of 12 ft 6 in. and a combined power of 50 tons. The hydraulic supply is taken from existing mains, and is at 1 ton per sq in. The preparation of the foundation required the excavation of more than 3500 cu yd of earth and the supply of 1500 cu yd of concrete.

The "Selectable Superheat" Marine Boiler

THE type of boiler used in the installation under test at the Pametrada Research Station is a development from the Babcock & Wilcox twin-furnace controlled-superheat boiler and appeared first to the public view (in model form, for obvious reasons) at the Engineering, Marine and Welding Exhibition held in London, England, in September.

Fig. 4 shows the principles of the design. The gas flow from the furnace is divided between two parallel passes, one containing banks of convection tubes and a superheater, and the other containing convection tubes only. The two sections are separated by a waterwall of studded tubes. Control of the gas flow in the two passes is by means of two sets of coupled dampers in the uptakes, one set being open while the other is closed. These can be seen in the diagram at the top left corner; the dampers in the superheater pass are shown closed and those in the saturated-steam pass are opened into the vertical position. After passing the dampers the two gas streams combine to pass through the economizer and/or air heater before being discharged to the uptake.

Apart from the variable steam temperature, which is a function of the damper position, the control of the boiler is the same as in the standard single-pass boiler. Automatic combustion control, if fitted, can be extended to operate the dampers also, giving a positive control of steam temperature at any preset figure. Boilers of this type can be made for evaporations of 35,000 lb per hr and upward; the example on test by Pametrada, obviously, has ten or twelve times that capacity.

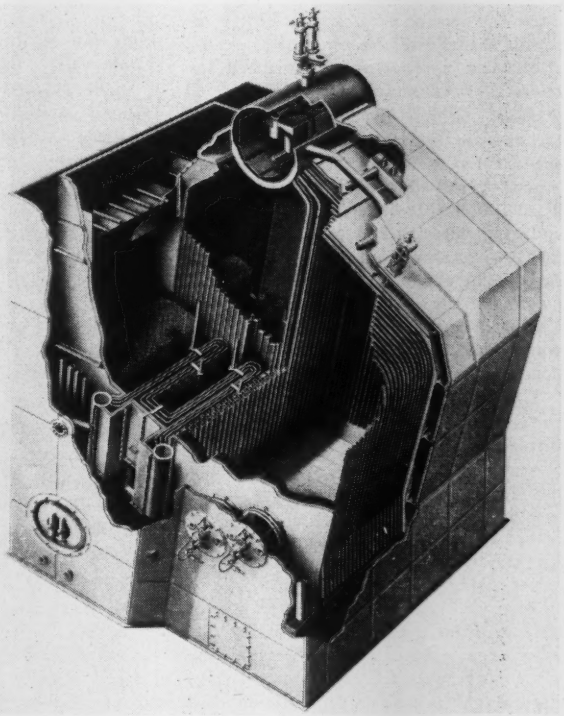


Fig. 4 Sectioned model of Babcock & Wilcox Selectable Superheat marine boiler, made for outputs of 35,000 lb per hr and upward

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Petroleum Mechanical Engineering

Practices in Displacing Liquid Hydrocarbons From Pipe Lines, by S. C. Phelps, Mem. ASME, Interstate Oil Pipe Line Company, Shreveport, La. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-24** (multilithographed; available to July 1, 1956).

In the relative short history of the pipe-line industry several thousand miles of pipe of all sizes from 2 in. to and including 16 in. have been displaced of their load of crude oil or refined products. These have been displaced for one of three basic reasons: (1) To permit extensive external repair where severe corrosion or other physical weakness dictate that for safety or other reasons repair of the line should not be attempted with the line loaded; (2) to permit internal cleaning (*a*) prior to switching to other service usually from crude oil to refined products or (*b*) prior to internal coating against internal-corrosion attack; and (3) to permit salvage of the pipe for re-use or sale where a pipe line has reached its physical or economical service life.

Basic methods of displacing hydrocarbons are limited in number. However, many variations of each are employed by various pipe-line companies depending on diameter, length, terrain, and numerous other factors. The mediums or substances used to displace hydrocarbons in the probable order of their magnitude are: Water, air, natural gas, Varsol or similar wash solutions, and water washes with detergents or alkaline degreasing compounds.

The pipe-line industry does not have the final solution to the problem of displacing a pipe line at this time. The three major methods using water, air, and gas have serious disadvantages under various conditions. None of the three leaves the displaced pipe in an entirely safe condition for salvage. Water is the safest, particularly if it does not have to be displaced prior to take-up. Danger of damage from freezing is its major disadvantage. Use of air is, in general, the most dangerous of all methods. Use of natural gas is safe if properly handled during the actual displacement but may be expensive. After the liquid is displaced, the gas cannot be disposed of in such a way that leaves a very safe line. Batches of Varsol and water-soluble degreasing compounds have been used in a limited way and all checking of samples done to date have shown a safe gas-free atmosphere in the pipe. Use of these is slow and expensive.

Hydraulic Pumping Units—An Engineering Look at the "Big Ones," by Douglas M. Jones, Mem. ASME, Axelson Manufacturing Company, Los Angeles, Calif. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-21** (multilithographed; available to July 1, 1956).

The Long Stroke Hydraulic Pumping Unit is a unique piece of machinery, interesting to engineers from four different angles.

1 As a powerful machine including prime mover, transmission, air-balance system, pump, fluid ducts, and 10-in. or so diameter piston with a 25 to 30-ft stroke, it is an effective assembly of tried and proved engineering elements.

2 As an oil-field production tool capable of lifting 1100 bbl per day from 6000 ft successfully using sucker-rod stresses several thousand psi over customary previous maximums.

3 With the big hydraulic unit as the mainstay of a team of prime mover, transmission unit, sucker rods, and pump, the design of this team for a production job is an absorbing problem in engineering.

4 Finally, with a pressure-sensitive dynamometer tied into the cylinder, a most interesting and useful record of the pulse of the well can be taken. Due to the nearly steady loads, the most accurate possible surface picture of loads and events in a well is recorded.

The purpose of the machine is to alternately raise and lower sucker rods of 25 or 30-ft lengths coupled together to extend several thousand feet to a subsurface plunger pump. A typical upstroke load might be 27,000 lb, with a downstroke load 15,000 lb. Maximum rated peak load is 30,000 lb with a 14,000-lb load range.

The main power source runs continuously and rotates the centrifugal pump in one direction through a V-belt drive and countershaft.

On the upstroke, the air under pressure in the reservoir forces the oil into the centrifugal pump-suction side with a net positive suction head of as much as 300 psi, while the pump adds the "boost" necessary to overcome losses and provide the required thrust under the piston to raise it against the upstroke load. At the end of the upstroke, a port is uncovered to actuate a pilot valve and thence the reverse valve to supercharge the pump suction now with pressure furnished by the falling weight of rods in the well on the downstroke. The pump furnishes the boost required to return its discharge as now routed through the manifold, into the reservoir, compressing the air and re-energizing it for its job of assisting the pump on the upstroke. Thus the air is a counterbalance which permits a fairly uniform power demand over the complete cycle.

The centrifugal pump is the heart of the unit. It has a heavy volute case, mechanical shaft seals, antifriction bearings, and a dynamically balanced impeller. With a recommended maximum rpm of 2200, it has a capacity of more than 1600 gpm and boost of over 130 psi.

Offshore Construction, by C. L. Graves, J. Ray McDermott & Co., Inc. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-32** (multilithographed; available to July 1, 1956).

One of the most interesting current developments pertaining to petroleum in the Gulf coast area at present is the ever-increasing search for petroleum and other minerals beneath the waters of the Gulf of Mexico on the Louisiana continental shelf. This paper reviews the problems encountered in selecting the type of foundation to use for drilling an offshore well together with the problems of its fabrication and erection. In its simplest terms, the problem is to provide a finished firm surface elevated above the crest of the highest assumed waves, supported through air, water, and mud by a rigid framework which in turn must

be founded and anchored in the underlying soils. These anchors must have sufficient penetration to resist maximum downward and upward loadings. There are three general types of structures which can be used in the drilling of wells offshore. These are as follows:

1 Large platforms having sufficient deck area to permit the installation of drilling equipment in much the same manner as on land, with complete living quarters either on the main platform or on a separate platform with connecting footbridge. This type of platform is commonly called the self-contained platform.

2 A small platform with which a floating tender vessel anchored adjacent to the platform is used.

3 Mobile platforms of various kinds.

Wave force and height data are presented to show their application in self-contained platform design. Wave forecasting in planning heavy lifts is described. Hurricane evacuation from self-contained platforms is discussed.

Use of Baillie wave roses for determining optimum tender orientation is described. Severe storm action on tender operation is shown.

Wave forces on mobile drilling units are described briefly. Requirements for forecasting services during periods of tow and setup on location are discussed.

Wave problems encountered in use of conventional drilling barges at offshore locations are discussed.

Part I—Effect on Thin-Walled Cylinders of Combined Loading From Tension and External Slip Compression; Part II—Application to the Problem of Oil-Well Casing Suspension, by Allen F. Rhodes, Mem. ASME, McEvoy Company, Houston, Texas, and James C. Wilhoit, Assoc. Mem. ASME, The Rice Institute, Houston, Texas. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-27** (multilithographed; to be published in Trans. ASME; available to July 1, 1956).

THIS paper provides the engineer with an analytical method for use in designing or evaluating oil and gas-well casing-suspension assemblies. It develops equation and stress and confirms their results by reports of controlled experiments. The design applications of the theory are discussed and detailed consideration given to an optimum casing-suspension design.

Review of Weather Problems Encountered in Gulf Coast Offshore Petroleum Operations During the Years 1947 to 1955, by A. H. Glenn, A. H. Glenn & Associates, New Orleans, La. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-30** (multilithographed; available to July 1, 1956).

EFFECTS of normal Gulf Coast weather and sea conditions and storms (hurricanes, squall lines, northers, and winter storms) on offshore construction and drilling are reviewed in terms of the four principal offshore-drilling methods (self-contained platforms, platform-and-tender, mobile drilling units, and conventional drilling barges).

Use of meteorological and oceanographic design studies and forecasting services to minimize operating hazards and improve efficiency is outlined.

Offshore Mooring of Drilling-Rig Tenders, by R. P. Knapp, Humble Oil & Refining Company, Houston, Texas, and H. V. Wait, Humble Oil & Refining Company, New Orleans, La. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-26** (multilithographed; available to July 1, 1956).

THIS paper describes the fixed-position mooring used to safely secure an LST-type drilling-rig tender, with its bow approximately 25 ft from a pile-founded platform at exposed locations in the Louisiana and Texas coastal areas of the Gulf of Mexico, where the water depth is approximately 60 ft. Design procedures used in the development of the mooring are presented, along with the design of a novel steel-pile-type anchor of unusual holding power. Difficulties encountered with standard chain-connecting links and three improved chain connectors developed for fixed-position moorings are discussed.

The deck fittings and machinery used to handle the vessel end of the mooring lines are outlined, together with operational considerations included in the installation, use, and abandonment of the mooring.

The conclusions reached were as follows:

1 Standards of mooring design currently in use by naval and civilian marine operators are generally suitable for use in the design of safe offshore drilling-rig-tender moorings.

2 The mooring forces may be calculated with reasonable accuracy.

3 The steel-pile type of anchor can develop, in soft bottoms, the holding power required for fixed-position moorings at exposed locations in the Gulf of Mexico.

4 The fatigue lifetime of the mooring chain and its appendages should be considered in the design and operation of drilling-rig-tender moorings.

5 For continuous service under cyclic tension loads it is not safe to use the Navy practice of determining the safe working load of chain cables as 35 per cent of the chain's ultimate breaking strength.

6 For maximum safety mooring chain cables should have a minimum number of connecting shackles located as near the anchors as possible, and these connections should have strength characteristics under cyclic tension loads equal to the common links of the chain cable.

7 The mooring lines should be of sufficient length to develop the maximum holding power of the anchors and to permit any required maneuvering of the drilling-rig tender.

8 A low initial tension in the mooring chain cables reduces the magnitude and frequency of their cyclic tension loads.

9 The mooring machinery and chain cables of drilling-rig tenders should be maintained in the best possible condition.

10 When a drilling-rig tender is maneuvered by means of the mooring lines at one end of the vessel care should be taken to avoid high-tension loading in the mooring lines at the other end, as the vessel may act as a long lever arm.

11 For safety and economy in drilling-rig-tender moorings the anchors should be placed in the designed positions with reasonable accuracy.

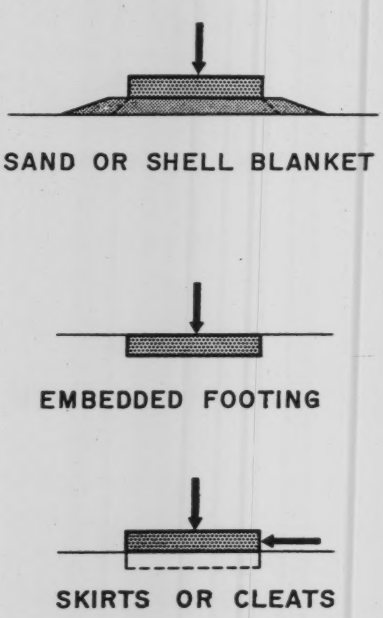
Volume Shrinkage Occurring in Blending Petroleum Products and Produced Distillates With Crude Oils, by H. M. Childress and M. B. Grove, Interstate Oil Pipe Line Company, Shreveport, La. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-25** (multilithographed; available to July 1, 1956).

THIS paper deals with a problem of system volume balance confronting crude pipe-line companies which receive separate consignments of crude oil, distillates, and plant products, and deliver a mixture of these liquids at the destination. With such an operation, a volume loss will occur in the pipe-line system. This loss or shrinkage in volume occurs as a result of blending together petroleum liquids which have very different compositions and characteristics. Such mixtures have been observed in the laboratory and in an operating system to deviate appreciably from ideality in that the total volume on mixing is less than the sum of the volumes of the components. Such behavior is considered natural and has been observed with other mixtures but data has not been available on the specific blends encountered in the average crude-oil pipe-line system. Presented in

this report are the results of a program of laboratory test and analysis which was conducted to determine the effect of this volume loss, and the variables affecting the loss, for those mixtures normally transported by crude pipe lines.

Soil Mechanics as Applied to Mobile Drilling Structures, by Bramlette McClelland and John A. Focht, Jr., McClelland Engineers, Houston, Texas. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-23** (multilithographed; available to July 1, 1956).

An ideal mobile oil-well drilling structure would be one which could be installed, operated, and moved in all weather conditions; it could also be erected in a wide range of water depths; and it would possess foundation stability at any desired location regardless of the existing soil conditions. It is reasonably certain that such an ideal structure can never be built and compromises are therefore necessary. All existing and proposed units are designed for certain limited ranges of water depth, a compromise with the ideal. Another compromise may include the acceptance of restriction against moving and erecting during unfavorable weather. In addition, it is also probable that no economical design can be prepared for a structure that will have foundation stability in all weather for all soil conditions which might be encountered.



Means of increasing load-carrying capacity of spread footings

Therefore selecting and defining the scope of operation of a proposed structure in terms of soil and weather conditions becomes one of the major tasks facing designers in this particular phase of offshore oil production.

The field of soil mechanics offers considerable aid to the designers of mobile drilling structures in enabling them to anticipate the foundation performance of proposed units under various soil conditions. Subsequent to design, soils engineering can also aid the operators of a mobile platform by determining in a more specific manner the probable foundation performance of the structure, by investigating and interpreting soil conditions at a given site. This paper deals in a general way with such applications of soil mechanics. All loads, both vertical and horizontal, applied to a drilling structure on location must be safely transmitted to the underlying soils through the supporting foundation units. In this paper, critical review is made of the abilities of the different types of foundation units to carry out this requirement. The limitations of soil-mechanics predictions and the need for more prototype information will also be discussed.

Photoelasticity a Useful Tool for the Oil-Tool Designer, by William M. Koch, Mem. ASME, Reed Roller Bit Company, Houston, Texas. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-22** (multilithographed; available to July 1, 1956).

Photoelasticity, according to this paper, seems to possess advantages that would make it a useful tool in working out designs. In the process, transparent models of the proposed design are employed. If a loaded model is viewed in a field of polarized light, a pattern of interference fringes will be seen that can be interpreted to indicate the magnitude of strains that exist in the model.

Up until quite recently, those interested in trying it out found, on further examination, that the equipment and material were quite expensive and the technique of making models difficult. However, recent developments have improved the situation so much that photoelasticity should now be regarded as a practical tool.

The phenomenon exhibited in photoelasticity has been known for a long time. The effect was first noted by Brewster in 1816, when he reported seeing colored patterns in glass when viewed by polarized light. Several physicists during the nineteenth century contributed to the knowledge of the effect, and Maxwell worked out most of the fundamental equations and demonstrated the use of the effect in determining strains. His main difficulty was the lack of any really suitable photoelastic materials. In the early part of the twentieth century, Professors Coker and Filon, using the newly invented material, Cellulid, developed photoelasticity to a practical science. However, celluloid was not very sensitive and polarizers were still expensive. In the 1930's the development of plastic materials with very high photoelastic sensitivities and the invention of polaroid again accelerated the use of photoelasticity in university laboratories and in some research departments. Now recent developments in plastics have resulted in materials so much cheaper and easier to use that it is felt that many more people will be interested in actually applying the technique to their own problems.

Pressure Drop for an Evaporating Fluid in a Tubular Heater, by Frank L. Maker, Mem. ASME, Standard Oil Company of California. 1955 ASME Petroleum Mechanical Engineering Conference paper No. **55—PET-29** (multilithographed; available to July 1, 1956).

The pressure drop in a tubular heater where the fluid is evaporating has generally been computed by a trial-and-error method that is time-consuming. This paper discusses the methods available and gives an example of a method by Ludwig which is very simple and fast for pressures above atmospheric, and where velocity-pressure effects are minor. This method does not work for pressures substantially below atmospheric. A simple graphical method of integrating the pressure back from the known required conditions at the outlet is developed. This is extended to take account of velocity pressure, which may be of the same order of magnitude as the friction in some cases. The method automatically signals when the assumed conditions are impossible by reason of exceeding the acoustic velocity.

Instruments and Regulators

Terminology of Process-Control Valves, by W. D. Washburn, Mem. ASME, Allied Chemical & Dye Corporation, Hopewell, Va., and R. Milham, The Foxboro Company, Foxboro, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-91** (multilithographed; available to October 1, 1956).

In the field of process control, the increasingly widespread use of control valves has produced a corresponding growth of specialized terminology.

This paper summarizes the results of an appraisal and correlation of current ter-

minology and presents a classification and glossary of recommended physical and functional terms for the restricted field of diaphragm-operated seat ring, and rising plug-type control valves.

The terminology presented is the result of a survey of technical papers, current manufacturers' literature, and of users' specifications.

Use of Nonlinear-Valve Characteristics in the Control of a Simple Blending Process, by J. L. Shearer, Mem. ASME, Massachusetts Institute of Technology. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-70** (in type; to be published in Trans. ASME; available to October 1, 1956).

A SIMPLE, continuous, energy-blending process is analyzed to attain an understanding of its dynamic performance when the flow rate of either the hot or cold fluid is time-variant. A linearized analysis based on small changes of all variables is employed to estimate the static and dynamic performance of the process when simple controllers are used to regulate temperature of the outflowing mixture.

Possible advantages are indicated for the use of nonlinear flow versus stroke characteristics of the flow-control valve together with its connecting lines. Graphical analyses show the performance of various control schemes when the system variables undergo large changes and indicate how valve characteristics may be chosen for the blending process under control.

Procedures for Evaluating Dynamic Characteristics of Valve Operators, by Andrew Bremer, Shell Development Company, Emeryville, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-110** (multilithographed; available to October 1, 1956).

A DESCRIPTION of the test equipment necessary for making step and frequency-response tests on pneumatic-valve motors is given, together with details of its operation.

The second section of the paper deals with the actual test procedures, such as (*a*) location of test equipment, (*b*) type of tests, (*c*) input signal amplitude, (*d*) static signal level, (*e*) frequency range, and (*f*) output loading conditions.

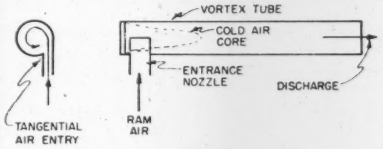
Procedures vary somewhat depending on the location of the valve and on the process considerations, and are discussed and justified for two general conditions, i.e., laboratory and field tests.

Examples showing the advantages and disadvantages of using valve positioners and volume boosters on valves in different types of processes are also discussed. These examples are included to show how the dynamic characteristics of valve operators can affect the over-all performance of control systems, and thus justify this type of test work.

Vortex-Tube Free-Air Thermometry, by L. S. Packer, Mem. ASME, and H. C. Box, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-22** (multilithographed; available to October 1, 1956).

IN an attempt to circumvent the difficulties of measuring ambient-air temperature from an airplane, the Ranque-Hilsch or vortex tube has been applied to subsonic free-air thermometry.

Reliable readings of at least ±1 deg C accuracy over a wide range of flight conditions were sought for military application. By simulating flight in the laboratory, two prototypes with the desired performance were developed. Limited flight tests confirmed the validity of the laboratory simulation method.



Schematic representation of uniflow vortex tube

It is concluded that a uniflow vortex tube is a successful free-air thermometer, but it is emphasized that several aspects of the application require further study.

Practical Limitations of Current Materials and Design of Control Valves, by H. H. Gorrie, Mem. ASME, Bailey Meter Company, Cleveland, Ohio, and W. L. Gantz, American Viscose Corporation, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-113** (multilithographed; available to October 1, 1956).

THIS paper has been written primarily for the engineer new in the control-valve field but is meant to serve both as an introductory and practical analysis of problems that must be considered when using control valves. A general explanation of body materials, bolting, valve trim, and packing gives some idea of the myriad of combinations of these factors that are actually used.

The Standards prepared by the American Standards Association, ASME, ASTM, and other neutral agencies, provide considerable guidance as to materials of construction for control-valve assemblies. Such sources constitute the authority for most of the information. Many of the larger "consumer" companies also have their own material and service standards with regard to materials. These, too, are excellent references but have limited utility since they are not universally available.

Design Basis for Multiloop Positional Servomechanisms, by Sidney Lees, Massachusetts Institute of Technology, Cambridge, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-126** (multilithographed; to be published in Trans. ASME; available to October 1, 1956).

A DESIGN basis for multiloop positional servomechanisms is developed by coordinating the specifications, dynamic characteristics, interferences, and uncertainties. The design basis arises from a consideration of the generation of torques by the system. The limitations of the system performance are distinguished from component characteristics. When the concept of frequency-dependent coefficients is employed, it is shown that the performance may be comprehended from knowledge of second-order systems.

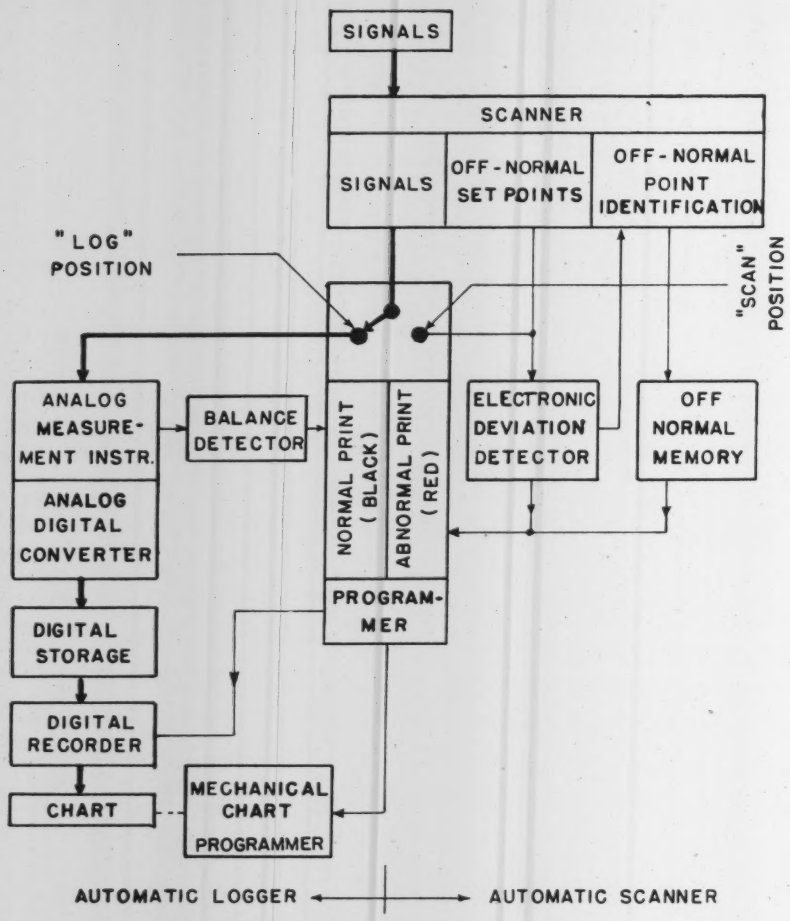
Seven models are examined. Estimates of useful values of the parameters for each model are confirmed by analog studies.

An Automatic Logging and Computation System for an Industrial Process, by Robert J. Marmorstone, Panellit, Inc., Skokie, Ill. 1955 ASME Instruments and Regulators Conference paper No. **55—IRD-13** (multilithographed; available to July 1, 1956).

WITHIN the past year extreme interest has been evidenced in automatic logging and computation systems. This paper describes such a system in detail with particular emphasis on the solution of various problems encountered in design. Automatic logging opens the door to more accurate accumulation of data in the laboratory and in industrial processes. Immediate evaluation of process variables can be achieved since the need for tedious manual logging, with its inherent transposition errors, is eliminated.

Gains also result from immediate computation, in terms of over-all efficiency increase in plant operation. The use of punched tape in conjunction with the logger makes possible the utilization of data in computers.

An automatic logging system periodically scans a large number of process



Basic building block diagram of the automatic logging and computing system

variables (pressures, temperatures, flows, etc.) and prints and arranges the process variables in a manner where this information can be quickly and efficiently reviewed by an operator. The basic building blocks of an automatic logging system are shown in the accompanying diagram.

The future of automatic logging of industrial processes is very bright. A back-up system of recording and graphic instrumentation will be used until sufficient confidence is placed in the logging system. Control of process variables will probably be guided by deviation instruments and trend recorders.

An initial problem will be the education of maintenance personnel. Down time could be a serious problem once back-up instrumentation is eliminated. However, it may be assumed that reliable long-life components will be used or developed as the field develops. Self-checking features within the logger are of prime importance. A "trouble-shooting" maintenance panel should be included as a basic part of each system. Great advances will be made in miniaturization. Amortization of logging equipment will be accelerated by improved techniques in manufacture.

Initially, punch-card output will provide the accounting department with daily output and other statistical data. Ultimately the output from the logging system will be fed directly into a computor from which feedback will be initiated.

Automation, Its Effects Upon the Future of the Process Industries, by Ira C. Bechtold, consultant, La Habra, Calif. 1955 ASME Instruments and Regulators Conference paper No. **55—IRD-12** (multilithographed; available to July 1, 1956).

THE impact of automation on the process industries within three areas is considered. The necessity for sensing methods specific to chemical properties of raw materials, intermediates, and products is discussed. A new approach to sampling methods and apparatus is indicated. The instrumentation system selected will sometimes dictate the selection of the process.

It is shown that a new philosophy of design and engineering of process plants will be required. Personnel particularly trained for a specialized type of "Operations Research" will be required.

Machine Design

Effect of Range of Stress in Combined Bending and Torsion Fatigue Tests of 25S-T6 Aluminum Alloy, by W. N. Findley, Brown University, and D. D. Strohbeck, Assoc. Mem. ASME, Boeing Aircraft Corp., Seattle, Wash. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-68** (in type; to be published in Trans. ASME; available to October 1, 1956).

FATIGUE-TEST data under bending, torsion, and combined bending and torsion are presented for mean stresses from zero to values which caused substantial yielding. The mean normal stresses in the bending and the torsion tests were corrected for the effect of the nonlinear distribution of stress resulting from yielding. The effect of stress relaxation at high mean stresses was investigated. The applicability of several theories of failure is compared with these test data. The influence of anisotropy, mechanism of crack formation, mean stress, and maximum stress are discussed.

The Influence of Shank Area on the Tensile Impact Strength of Bolts, by J. Love, Jr., Assoc. Mem. ASME, General Electric Company, Cincinnati, Ohio, and O. A. Pringle, Assoc. Mem. ASME, The University of Missouri, Columbia, Mo. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-77** (multilithographed; to be published in Trans. ASME; available to October 1, 1956).

THE effect of reduction of shank cross-section area on the tensile impact strength of $^5/_{16}$, $^3/_8$, and $^7/_{16}$-in. steel bolts was investigated experimentally.

Low-carbon $^3/_8$-in. bolts with rolled threads absorbed maximum impact energy when the ratio of shank area to thread-root area was equal to 1.23. Heat-treated, medium-carbon $^3/_8$-in. bolts absorbed maximum impact energy when the ratio of shank area to thread-root area was equal to 1.17 for shanks reduced by drilling or 1.12 for shanks reduced by turning. Results for other sizes were similar.

It was concluded that for maximum energy absorption the shank area should

approximately equal the mean or tensile-stress area of the threads, with minor corrections to compensate for work hardening due to thread rolling or surface oxidation resulting from heat-treatment.

Design Improvements in Industrial Electrical Motors and Controls, by T. Turner, Mem. ASME, and C. Lynn, Mem. ASME, Westinghouse Electric Corporation, Buffalo, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-93** (multilithographed; available to October 1, 1956).

THE early industrial a-c induction motor with about 5-hp output made in 1890, had a weight of approximately 1000 lb and sold for $880. Today an NEMA standard motor of the same rating weighs about 110 lb and sells for a little more than $100 with today's dollar worth about 15 cents in terms of the dollar of 1890.

While the fundamental theory of the operation of electric motors was established in the first quarter of the nineteenth century, it was not until about 1890 that practical alternating-current motors suitable for industrial use could be purchased from electrical manufacturers. The authors' company pioneered the use of alternating current and developed the squirrel-cage, induction-type motor that has so many thousands of applications today.

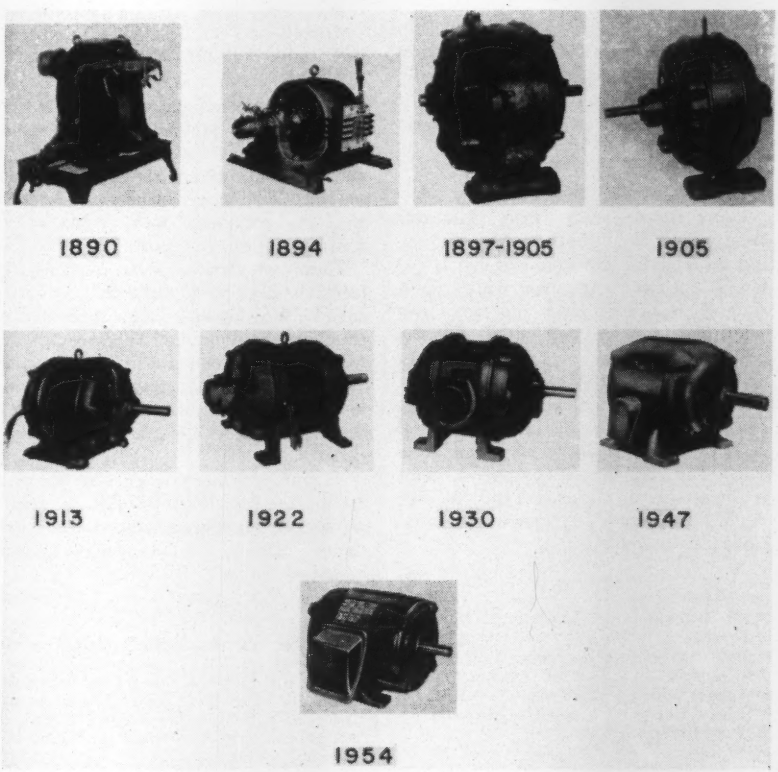
This paper covers the accomplishments of engineers and others in improving industrial a-c and d-c motors and controls, particularly in the last five to 10 years.

The Spring Back of Metals, by F. J. Gardiner, Circuit Breaker Company, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-66** (in type; to be published in Trans. ASME; available to October 1, 1956).

A GENERALIZED and simplified mathematical analysis and derivation for a spring-back correction curve for pure bending is given. Extensive test data, especially for "springy" materials are shown. Qualitative reasons are given for their departure from the theoretical curve. An optimum empirical curve is plotted, showing a band of most probable values. The utilization of this general spring-back curve is described and a worked example is given.

Whereas no data have been accumulated on brass and bronze materials, it is believed that these will fall into the bands set by data on aluminum, nickel-base, titanium, and ferrous alloys. It is recommended that all tooling for metals whose ratio of yield stress to elastic modulus S/E lies between 1.1 and 5.0 $\times 10^{-3}$ be treated in accordance with the spring-back correction factors. As soon as this ratio S/E and the material thickness have been determined, a chart of tool radius R versus resultant part radius r may be prepared.

This chart is then used by the tool designer to specify the tool shape. Conservation of thickness and length is a necessary assumption. Whereas many sheet-metal-forming operations do not require spring-back correction, there is a large savings in "tool-development" time in those cases where the spring back is large and cumulative.



Westinghouse industrial induction motors covering the period 1890 to 1954

Lubrication

Experimental Verification of Theoretical Investigations Into Half-Frequency Whirl, by B. Sternlicht, Mem. ASME, General Electric Company, Schenectady, N. Y. 1955 Joint ASME-ASLE Lubrication Conference paper No. **55—LUB-20** (multilithographed; available to August 1, 1956).

THE problem of "half-frequency whirl" has been investigated for journal bearings operating in horizontal machines.

This investigation consists of a theoretical bearing-stability analysis and an experimental verification of the theory for two-bearing applications. In one of the applications the journal operates at speeds above the second critical, while in the other application the operation is at speeds below the first critical.

Analytical Study of Journal-Bearing Performance Under Variable Loads, by G. S. A. Shawki, Cairo University, Cairo, Egypt. 1955 Joint ASME-ASLE Lubrication Conference paper No. **55—LUB-16** (multilithographed; available to August 1, 1956).

THIS paper presents basic theoretical investigations into the performance of a complete journal bearing of infinite width under conditions of variable load. The theory excludes the existence of negative pressure (below vapor pressure) in the lubricating film.

Analytical solutions are given for few simple cases; they show closer agreement with experiment than those attained by previous theory.

Owing to the complexity of the equations involved in the analysis, solutions may, in general, be effected only by numerical computations; tables of relevant functions are included.

Further work on the subject is proceeding.

Applied Mechanics

Stress Concentration Caused by Multiple Punches and Cracks, by Michael Sadowsky, Mem. ASME, Rensselaer Polytechnic Institute, Troy, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-16 (in type; to be published in the *Journal of Applied Mechanics*).

THE paper contains (*a*) a general theory of stress distribution under several punches in simultaneous action and of stress concentration caused by several cracks; (*b*) a complete evaluation for the case of two punches or two cracks.

Considerable stress interference is found with punches (cracks) close to each other.

General Solutions of the Equations of Elasticity and Consolidation for a Porous Material, by M. A. Biot, Mem. ASME, Shell Development Company, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-7 (in type; to be published in the *Journal of Applied Mechanics*.)

EQUATIONS of elasticity and consolidation for a porous elastic material containing a fluid have been previously established. General solutions of these equations for the isotropic case are developed, giving directly the displacement field or the stress field in analogy with the Boussinesq-Papkovitch solution and the stress functions of the theory of elasticity.

General properties of the solutions also are examined and the viewpoint of eigenfunctions in consolidation problems is introduced.

A Matrix Solution for the Vibration Modes of Nonuniform Disks, by F. F. Ehrich, Assoc. Mem. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-17 (in type; to be published in the *Journal of Applied Mechanics*).

AN arbitrary disk is represented by a simulated disk composed of circumferential strips. Alternate strips are considered to be massless, constant-thickness elements with the average local elastic properties of the actual disk. Intermediate strips are considered to have the properties of local mass and polar moment of inertia, but to have no physical dimensions or elasticity. A matrix vector, formed of the local antinodal value of deflection, slope, moment, and transverse force, may be operated on by matrices representative of the elastic strips and by matrices representative of the vibratory inertia loading, centrifugal inertia loading, internal stress, and external supports at the mass strips. Thus the influence of boundary conditions at the outer edge on conditions at the inner edge may be calculated in a simple efficient manner. Successive guesses of vibration frequency lead to final satisfaction of all boundary conditions.

Concise treatment of all types of boundary conditions and numerical values of required matrices are given in tables. Results of a sample calculation are compared with exact analytic results.

Determination of Natural Frequencies of Continuous Plates Hinged Along Two Opposite Edges, by A. S. Veletsos, Assoc. Mem. ASME, and N. M. Newmark, Mem. ASME, University of Illinois, Urbana, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-11 (in type; to be published in the *Journal of Applied Mechanics*)

A NUMERICAL procedure is presented for computing the undamped natural frequencies of bending vibration of rectangular plates which are hinged along two opposite edges and continuous over rigid supports transverse to the hinged edges. Along the hinged edges there are assumed to be uniformly distributed forces acting in the middle plane of the plate.

The procedure is illustrated by two examples.

Bending Vibrations of Variable-Section Beams, by E. T. Cranch, Cornell University, Ithaca, N. Y., and Alfred A. Adler, Cornell Aeronautical Laboratory, Buffalo, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-19 (in type; to be published in the *Journal of Applied Mechanics*).

USING simple beam theory, solutions are given for the vibration of beams having rectangular cross section with (*a*) linear depth and any power width variation, (*b*) quadratic depth and any power width variation, (*c*) cubic depth and any power width variation, and (*d*) constant depth and exponential width variation.

Beams of elliptical and circular cross section are also investigated. Several cases of cantilever beams are given in detail. The vibration of compound beams is investigated. Several cases of free double wedges with various width variations are discussed.

A Suction Device Using Air Under Pressure, by L. F. Welanetz, Mem. ASME, Fairchild Camera and Instrument Corporation, Syosset, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-38 (in type; to be published in the *Journal of Applied Mechanics*).

AN analysis is made of the suction holding power of a device in which a fluid flows radially outward from a central hole between two parallel circular plates. The holding power and the fluid-flow rate are determined as functions of the plate separation.

The suction-holding device has a force characteristic which increases as the flow rate of the fluid increases until a maximum is reached. For a higher flow rate the holding force decreases. Also, for very small and very large flow rates the direction of the force is reversed.

For maximum holding power the central tube should have a diameter 0.25 to 0.30 times the disk diameter. The central tube should be short and well formed to reduce energy losses.

Tests with a short, rounded, central tube with diameter 0.25 times the disk diameter gave general agreement with the analysis for the smaller values of plate separation. The predicted maximum total-force factor was obtained. The predicted flow rates at large plate separations were not obtained, probably because of flow separation.

Unsteady Radial Flow of Gas Through Porous Media—Variable Viscosity and Compressibility by J. S. Aronofsky, Mem. ASME, Magnolia Petroleum Company, Dallas, Texas, and J. D. Porter, Massachusetts Institute of Technology, Cambridge, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-13 (in type; to be published in the *Journal of Applied Mechanics*).

CALCULATIONS of pressure-time histories and flow rates are presented for radial unsteady flow of gases through porous media. Some nonideal gas properties are considered by expressing gas viscosity and gas compressibility (z-factor) as simple functions of pressure.

These calculations were obtained by using the high-speed electronic computer called "Whirlwind" which is located at the Digital Computer Laboratory of the Massachusetts Institute of Technology.

The results demonstrate that variable viscosity and compressibility can exert a substantial effect on transient gas-flow systems.

A simple means is suggested for estimating the velocity of gas flowing across an inner radial boundary into a hole when the gas pressure is held constant at that boundary.

The Effect of the Earth's Rotation on Laminar Flow in Pipes, by G. S. Benton, The Johns Hopkins University, Baltimore, Md. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-9 (in type; to be published in the *Journal of Applied Mechanics*).

THE theory of laminar pipe flow has

been developed retaining the effect of the earth's rotation. It is shown that this effect depends on the component of the earth's rotation normal to the pipe, and is thus a maximum for flow in the east-west direction. Weak secondary circulations form in the cross-sectional plane. The intensity of these circulations, expressed nondimensionally, is proportional to the ratio of the Reynolds number and the Rossby number.

The cross circulations and the associated pressure field are extremely weak, even for flow at high Reynolds numbers. However, this flow tends to cause an asymmetry in the axial velocity distribution which can be significant, especially when the ratio of the square of the Reynolds number to the Rossby number exceeds 5×10^2. High velocities are displaced from the pipe axis in a direction specified by the negative cross product of the vectors parallel to the earth's axis and to the direction of fluid discharge.

Laboratory experiments indicate the existence of such asymmetric flows. However, the measured asymmetry is about one third of the theoretical value. This is attributed to the fact that the pipe system used was probably insufficient in length to allow the secondary flow associated with the earth's rotation to become fully developed.

Theory and experiment both indicate that under certain circumstances the effect of the earth's rotation on pipe flow is not negligible. In particular, this factor may be of importance in the breakdown of laminar flow into turbulence at high Reynolds numbers. This subject warrants further investigation.

Analysis of Slip Damping With Reference to Turbine-Blade Vibration, by L. E. Goodman, Assoc. Mem. ASME, and J. H. Klumpp, Assoc. Mem. ASME, University of Minnesota. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-80** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

ENERGY of vibration may be dissipated by microscopic slip-on interfaces where machine elements are joined in a press fit. In this paper slip damping is studied as an agent in reducing turbine-blade resonant stresses and prolonging turbine life. A general theory of slip damping is developed and an expression for the energy loss per cycle of oscillation is found. The predictions of the theory are compared with the results of controlled experiments. It appears that the theory is in satisfactory agreement with experiment and with measurements made on turbine blades elsewhere in this country and abroad.

The implications of the general theory in the design of turbine blades are discussed. It appears that slip damping is capable of being an effective agent in reducing resonant stresses, especially in the "stall-flutter" condition where aerodynamic damping is inadequate. The design of a slip-damping joint which would achieve theoretically possible energy decrements much larger than are present in existing commercial construction is shown to depend on the maintenance of an optimum contact pressure.

Plastic Twisting of Thick-Walled Circular Ring Sectors, by W. Freiberger and W. Prager, Brown University. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-85** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE paper presents a graphical method of determining the fully plastic stress distribution in a twisted circular-ring sector with hollow cross section and the warping of the cross sections of this ring in the ensuing plastic flow. The ring is assumed to consist of a rigid, perfectly plastic material.

A Method of Stepwise Integration in Problems of Impact Buckling, by A. F. Schmitt, Purdue University, Lafayette, Ind. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-37** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE equations for the dynamic buckling of an axially impacted column are discussed.

A method is presented for the calculation of approximate load and deflection variations in problems of high-velocity impact. The method may be extended for cases wherein the stresses exceed the elastic limit.

Results of calculations are presented for two cases. In one of these, agreement with a previous exact solution is found to be good.

A Method for Calculating Stress-Concentration Factors, by M. Hetenyi, Mem. ASME, Northwestern University, Evanston, Ill., and T. D. Liu, California Research Corp., La Habra, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-81** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

IT IS shown in this paper that along the root sections of filleted or notched bars there is a rapid rise in the transmitted shearing forces, and this may be regarded as the principal reason for the occurrence of stress peaks under these circumstances. By making a few assumptions concerning the distribution of these shear loads, the stress-concentration factors can be calculated with satisfactory accuracy for such cases which have been heretofore analytically intractable.

Tensor-Flexibility Analysis of Pipe-Supporting Systems, by J. W. Soule, United Engineers and Constructors, Inc., Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-82** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

A GENERAL tensor method of analysis is used to derive the equations of performance of a complete piping system, including effect of pipe weight, supports, and thermal expansion.

Critical Thickness of Surface Film in Boundary Lubrication, by I-Ming Feng, Bendix Aviation Corp., Detroit, Mich., and C. M. Chang, Massachusetts Institute of Technology. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-84** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

WHEN the combined equivalent thickness of the surface film approaches and finally becomes greater than the critical value, the weakening of the interlocking effect of the plastic roughening results in rapid decrease in wear and ultimately reduces wear to practically zero. This is verified by experimental results of wear of pure metals with controlled surface film thickness in the region near the critical thickness.

Flexural Vibrations of Rectangular Plates, by R. D. Mindlin, Mem. ASME, Columbia University, New York, N. Y., A. Schacknow, Republic Aviation Corp., Long Island, N. Y., and H. Deresiewicz, Assoc. Mem. ASME, Columbia University, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-78** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE influence of rotatory inertia and shear deformation on the flexural vibrations of isotropic, rectangular plates is investigated. Three independent families of modes are possible when the edges are simply supported. Coupling of the modes is studied for the case of one pair of parallel edges free and the other pair simply supported. The development of

the coupling is traced by means of a solution for elastically supported edges. Special attention is given to the higher modes and frequencies of vibration which are beyond the range of applicability of the classical theory of thin plates.

The Solution of Multiple-Branch Piping Flexibility Problems by Tensor Analysis, by J. W. Soule, United Engineers and Constructors, Inc., Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-83** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

A GENERAL method of flexibility analysis is presented which, by the use of tensors, makes it possible to derive the equations of performance of highly complex piping systems by a routine procedure.

Theoretical Considerations of Combined Thermal and Mass Transfer From a Vertical Flat Plate, by E. V. Somers, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-48** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

IN free-convective processes involving both thermal and mass transfer, since the driving force for the fluid motion has its source solely in the density difference from ambient, it is necessary to consider the thermal and mass-transfer processes simultaneously in solving any given problem.

The present problem involves evaporation and condensation phenomena associated with free-convective thermal and mass transfer from a wetted isothermal vertical flat plate to a gas at an ambient temperature and mass concentration different from that on the plate. This problem presents itself in the practical case of vaporization cooling of equipment without forced circulation of the ambient gas.

ASME Transactions for November, 1955

THE November, 1955, issue of the Transactions of the ASME, which is available at $1 per copy to ASME members; $1.50 to nonmembers contains the following:

Technical Papers

The Short Bearing Approximation for Plain Journal Bearings, by G. B. DuBois and F. W. Ocvirk. (54—LUB-5)

Studies in Lubrication—X, by M. J. Jacobson, A. Charnes, and E. Saibel. (54—LUB-10)

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—IX, by F. Osterle, A. Charnes, and E. Saibel. (54—LUB-11)

Measurement of Total Emissivities of Gas-Turbine Combustor Materials, by S. M. De Corso and R. L. Coit. (54—SA-26)

Modified Residual Fuel for Gas Turbines, by B. O. Buckland and D. G. Sanders. (54—A-246)

Experimental Determination of the Thermal-Entrance Length for the Flow of Water and of Oil in Circular Pipes, by J. P. Hartnett. (54—A-184)

Turbulent Heat Transfer and Friction in the Entrance Regions of Smooth Passages, by R. G. Deissler. (54—A-154)

An Approximate Solution of Compressible Turbulent Boundary-Layer Development and Convective Heat Transfer in Convergent-Divergent Nozzles, by D. R. Bartz. (54—A-153)

The Influence of Curvature on Heat Transfer to Incompressible Fluids, by Frank Kreith. (54—A-55)

Heat Transfer and Pressure Drop for Viscous-Turbulent Flow of Oil-Air Mixtures in a Horizontal Pipe, by H. A. Johnson. (54—A-150)

Numerical Solutions for Laminar-Flow Heat Transfer in Circular Tubes, by W. M. Kays. (54—A-151)

An Interferometric Study of Free-Convection Heat Transfer From Enclosed Isothermal Surfaces, by C. D. Jones and D. J. Masson. (54—A-147)

Free-Convection Heat Transfer From a Rotating Horizontal Cylinder to Ambient Air With Interferometric Study of Flow, by G. A. Etemad. (54—A-74)

Through-Flow in Concentric and Eccentric Annuli of Fine Clearances With and Without Relative Motion of the Boundaries, by L. N. Tao and W. F. Donovan. (54—A-175)

A Theory of the Fluid-Dynamic Mechanism of Regenerative Pumps, by W. A. Wilson, M. A. Santalo, and J. A. Oelrich. (54—A-59; 54—A-60)

Predictor Control Optimalizes Control-System Performance, by L. M. Silva. (54—A-132)

The Effect of Wheel-Work Conformity in Precision Grinding, by R. S. Hahn. (54—A-178)

Shear-Plane Temperature Distribution in Orthogonal Cutting, by J. H. Weiner. (54—A-65)

Stresses and Strains in Cold-Extruding 2S-O Aluminum, by E. G. Thomsen and J. Frisch. (54—A-161)

Accuracy and Results of Steam-Consumption Tests on Medium Steam Turbine-Generator Sets, by D. E. Kimball. (54—A-253)

Experience in Testing Large Steam Turbine-Generators in Central Stations, by E. M. Kratz. (54—A-258)

Heat and Mass Transfer in Spray Drying, by W. R. Marshall, Jr.

Possibilities of Burning Lower-Cost Diesel Fuels, by Ray McBrian. (54—A-250)

Thermal Conductivity of Gases, by F. G. Keyes. (54—A-235)

ASME Papers Order Form

Copies of ASME technical papers digested this month are available in pamphlet form. Please order only by paper *number;* otherwise the order will be returned. Orders should be addressed to the ASME Order Department, 29 W. 39th St. New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 to members; $4 to nonmembers.

Note: No digests are made of ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th Street, New York, N. Y.

ASME Transactions and the *Journal of Applied Mechanics* are on file in the main public libraries of large industrial cities and in the technical libraries of engineering colleges having ASME Student Branches.

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How ASME Celebrated Its 75th Anniversary

By Jess H. Davis

President, Stevens Institute of Technology, Hoboken, N. J. and Chairman, ASME 75th Anniversary Committee. Member ASME

With 1955 and the celebration of the 75th Anniversary of the founding of The American Society of Mechanical Engineers drawing to a close, it would seem appropriate to render an accounting of the celebration.

In accomplishing the objects of the anniversary, it was decided that the celebration should be a series of vital and significant events during the course of the entire year 1955. These events should provide opportunity for the Society to re-emphasize and dramatize its objects, appraise its accomplishments, and project them into the future. They should also provide the Society with the opportunity to strengthen and refreshen its relations with related societies, and to rededicate itself to the forwarding of its public services and the advancement of its educational functions. The celebration should further provide an opportunity for the Society to give added recognition to the influence of the technical press and to epitomize the various phases of all its work in the minds of the ASME member, the prospective ASME member, and the general public.

Theme

It was natural with the breadth of the objects of the Society's celebration that a broad theme be selected within which the celebration would be developed. The theme selected was The Engineer in Our World.

Separate themes were selected for the five major national meetings planned during the year, each designed to explore a specific phase of that broad theme and to tell something about the engineer and the world in which he lives and works. Three of these meetings were to be the usual technical-type meetings and two were to be special commemorative meetings. Special panel sessions were developed for each of these meetings to explore the themes assigned.

Development of the Theme

Founding Anniversary Meeting—The Engineer and the World of Communications. The first of these meetings was the Founding Anniversary Meeting, held on Feb. 16, 1955, in New York. Since the founding of ASME took place in the offices of the *American Machinist*, the theme assigned to this meeting was "The Engineer and the World of Communications." At a commemorative session in the morning in the auditorium of the McGraw-Hill Publishing Company, publishers of *American Machinist*, about 125 editors and publishers in the technical field and members of the Society witnessed the presentation of greetings to ASME by delegates from 19 associations and societies representing the various communications media and fields, and heard an address by Dr. Morgan, president of ASME.

Objects of the Celebration

In planning the ASME Diamond Jubilee year, one of the first acts of the 75th Anniversary Committee was to delineate the objects of the celebration. These objects were as follows:

1 To enhance the prestige and recognition of the Society among mechanical engineers.

2 To enhance the prestige and recognition of the Society among the engineering profession.

3 To enhance the prestige and recognition of the Society among the engineering colleges—both faculty and students.

4 To enhance the prestige and recognition of the Society among industry and the government—especially those in top management.

5 To increase the Society's membership.

After a buffet luncheon, a special session on "The Engineer and His Communications" was held in the auditorium of the Engineering Societies Building. This session was chaired by Willard T. Chevalier, executive vice-president of McGraw-Hill Publishing Company, and the panelists included Edgar Kobak, president of the Advertising Research Foundation; James O. Lyne, president, Simmons-Boardman Publishing Company; Ormond J. Drake, assistant secretary, New York University; and E. W. Engstrom, executive vice-president, research and engineering, Radio Corporation of America.

In the evening at a dinner in the Sert Room of the Waldorf-Astoria Hotel, presided over by William L. Batt, past-president of ASME, those present witnessed the presentation of the 1955 Worcester Reed Warner Medal to Howard S. Bean, the conferral of an honorary membership upon Vannevar Bush, and listened to a major address[1] by Dr. Bush, "Communications—Where Do We Go From Here?"

Organization Anniversary Meeting—The Engineer and the World of Education. A second general Society meeting, commemorating the organization of ASME on April 7, 1880, in the assembly hall at the Stevens Institute of Technology, Hoboken, N. J., was held on April 16, 1955, on the campus at Stevens Tech. Since the Organi-

[1] See Mechanical Engineering, vol. 77, no. 4, April, 1955, pp. 302–304.

zation Meeting of the Society was held at Stevens Institute of Technology, it was decided that at this meeting it would be most appropriate to explore the field of education. Accordingly, the theme of this meeting was "The Engineer and the World of Education." A convocation was held during the morning in the same auditorium in which the organization meeting had been held 75 years previously. Those present witnessed the presentation of greetings to ASME from delegates representing 108 universities and colleges of the United States and Canada, 43 engineering societies and engineering joint bodies of the United States and Canada, 8 engineering fraternities, and the American Council on Education.

At a luncheon, presided over by L. F. Grant, president of Engineers' Council for Professional Development, those present witnessed a presentation of the 1954 Holley Medal to Walter A. Shewhart, and heard an address by Arthur S. Adams, president of the American Council on Education, "As the Wheels Turn."

The program concluded with an afternoon panel session on "The Engineer and the World of Education," presided over by A. G. Christie, past-president of ASME. The panel members were Blake R. Van Leer, president, Georgia Institute of Technology; C. Richard Soderberg, dean of engineering, Massachusetts Institute of Technology; Mervin J. Kelly, president, Bell Telephone Laboratories; and Joseph M. McDaniel, Jr., secretary of the Ford Foundation.

Diamond Jubilee Spring Meeting—The Engineer and the World of Government. At the Diamond Jubilee Spring Meeting in Baltimore, Md., April 17 to 22, 1955, the 75th Anniversary was commemorated in two panel sessions and at the banquet. The theme of this meeting was "The Engineer and the World of Government."

The first panel was held on Tuesday afternoon, April 19, on the subject, "The Engineer's Responsibilities to Government." Harold V. Coes, past-president ASME, was the chairman, and the panel members were Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering); R. E. Gillmor, retired vice-president, The Sperry Corporation; Harold V. Coes and John J. O'Donnell, Acting Director of Public Improvements, the State of Maryland. At the banquet on Tuesday evening, April 19, presided over by Ralph E. Flanders, U. S. Senator from Vermont and past-president ASME, those present witnessed the presentation of the 1955 ASME Medal to Granville M. Read, and heard an address[2] by Lieut. General Leslie R. Groves, USA (ret.), vice-president of Remington Rand, Inc., "Dispersal of Industry in the Atomic Age."

The second panel was held on Wednesday morning, April 20, on "The Engineer and the Prospects for Peace." Walker L. Cisler, president of the Detroit Edison Company, was chairman, and the panel members were Dimitri Shimkin[3] of the Bureau of the Census; Granville M. Read, chief engineer, E. I. du Pont de Nemours & Company, Inc.; and John Bell Rae, associate professor of history in the Department of the Humanities, Massachusetts Institute of Technology.

Diamond Jubilee Semi-Annual Meeting—The Engineer and the World of Science. At the Diamond Jubilee Semi-Annual Meeting, held in Boston, Mass., June 19 to 24, 1955, the 75th Anniversary was commemorated in a convocation, two panel sessions, and a banquet. The theme of this meeting was "The Engineer and the World of Science."

[2] See MECHANICAL ENGINEERING, vol. 77, no. 6, June, 1955, pp. 486–487.

[3] See MECHANICAL ENGINEERING, vol. 77, no. 8, August, 1955, pp. 681–682.

Proclamation

THREE quarters of a century ago a few far-sighted leaders founded The American Society of Mechanical Engineers to promote "the arts and sciences connected with engineering and mechanical construction," to provide means for the mutual and self improvement of engineers, and to render greater service to mankind.

In the years that have passed, the imagination, competence, and energy of our members, individually and in association with others who have given freely of their time and resources, have borne fruit in the glorious record of such accomplishments as engineers are fitted by genius and experience to attain in the advancement of peace and the material welfare of the free world.

It is now my duty and privilege on behalf of the Council to proclaim 1955 as the Seventy-Fifth Anniversary of the Society, to be celebrated in an appropriate manner throughout the nation and throughout the year.

By means of this celebration we rededicate the Society to the task of building our nation's engineering strength for greater service in the ever-widening fields of engineering application.

In the spirit which animated our Founders we rededicate our Society—

BY TRUTH AND BY SERVICE
TO ENRICH MANKIND

New York, N. Y.
December 1, 1954

DAVID W. R. MORGAN *President, 1955*

At the convocation, held on Tuesday afternoon, June 21, those present witnessed the presentation of greetings to ASME from delegates representing 16 scientific societies and fraternities of the United States, 14 engineering societies from abroad, and 4 international engineering organizations. The convocation was immediately followed by the first panel on "The Relationships of the Engineer and His Fellow Scientist." The chairman was R. J. S. Pigott, past-president ASME, and the panel members included Frederick G. Keyes, professor of physical chemistry, Massachusetts Institute of Technology; Bostwick H. Ketchum, Woods Hole Oceanographic Institution; and Carl W. Walter, M.D., associate clinical professor of surgery, Harvard Medical School, and president, Fenwal, Inc.

At the banquet held on Tuesday evening, and presided over by F. S. Blackall, jr., past-president ASME, those present witnessed the presentation of the Boston Section's 75th Anniversary Medal to Alfred J. Ferretti; the 1955 ASME George Westinghouse Gold Medal to Rear Admiral H. G. Rickover, USN; the conferral of honorary memberships on Jacob Ackeret of Switzerland; Detlev W. Bronk, president of the National Academy of Sciences; Sir Vincent de Ferranti, chairman of the International Executive Council of the World Power Conference; Richard E. Heartz, president of the Engineering Institute of Canada; Ernest F. Mercier of France; and Hilding V. Törnebohm, president of the International Organization for Standardization; and heard an address by Detlev W. Bronk.

The second anniversary panel was held on Wednesday morning, June 22, on "The Engineer and the World of Science." William L. Batt, past-president ASME, was chairman, and the panelists included Sir Vincent de Ferranti, Richard E. Heartz, and Hilding V. Törnebohm.

Diamond Jubilee Annual Meeting—The Engineer and the World of Commerce and Industry. The 75th Anniversary celebration reached its climax in the recent Diamond Jubilee Annual Meeting held in Chicago, Ill., Nov. 13 to 18, 1955. The theme for that meeting was "The Engineer and the World of Commerce and Industry."

In addition to the usual technical program, Thursday, November 17, was designated "Diamond Jubilee Day." At a convocation in the morning those present witnessed the presentation of greetings to ASME from delegates representing eight professional societies and 20 industrial groups with which ASME has been associated.

Immediately following the convocation a special panel, moderated by James D. Cunningham, past-president ASME, and composed of Joseph B. Armitage, vice-president of Kearney & Trecker, Milwaukee, General James H. Doolittle, vice-president of Shell Oil Company, Samuel B. Earle, dean-emeritus of engineering, Clemson Agricultural College, Simes T. Hoyt, consultant, Castle & Cooke, Ltd., Carl G. A. Rosen, consultant, Caterpillar Tractor Company, and Clyde E. Williams, president, Battelle Memorial Institute, discussed "The Economic Aspects of Technology."

At a Joint Honors Luncheon, presided over by Thorndike Saville, president of Engineers Joint Council, those attending witnessed the conferring of the major joint engineering honors and awards. These included the John Fritz Medal to Philip Sporn, Fellow ASME; the Hoover Medal to Charles F. Kettering, Fellow ASME; the Henry Laurence Gantt Gold Medal to Walker L. Cisler, Fellow ASME; and The Elmer A. Sperry Award to William Francis Gibbs, Fellow ASME. An announcement of the award of the Daniel Guggenheim Medal to Theodore von Karman, Mem. ASME, was made at the luncheon. The recipients were provided an opportunity to respond at a special session in the afternoon on "The Engineer and the World of Commerce and Industry."

The year's climax was reached in the Diamond Jubilee Annual Banquet on Thursday evening of the Annual Meeting, at which a number of honorary memberships and other ASME honors were conferred, and those attending heard an address by Roy T. Hurley, chairman and president, Curtiss-Wright Corporation.

Symbol and Motto

The Committee conducted a contest among the members during 1954 to select a symbol and slogan for 1955. The contest was concluded during the summer and the winners were announced on Sept. 9, 1954.

The winner of the symbol contest was Andrew T. Lemmens of Rochester, N. Y., with his combination of the heat and nuclear cycles symbolizing the advances of 75 years in the generation of mechanical energy and their effect on the world in which we live. Certificates were awarded to winners in each of the Society's eight regions and for the best symbol submitted from abroad.

Dr. David H. Ray of North Tarrytown, N. Y., submitted the winning motto "By Truth and by Service to Enrich Mankind." As in the symbol contest, certificates were also awarded to the regional winners and for the best motto submitted from abroad.

The winning symbol and slogan were incorporated in a special Diamond Jubilee Medallion cast in bronze two inches in diameter that was placed on sale at cost to members of the Society throughout the year. A special 75th Anniversary Medal and a 75th Anniversary Student Award, similar in design to the Medallion, were cast.

Spread of the Celebration

Conforming to its plan to spread the celebration of ASME's 75th Anniversary into meetings and special events all during 1955, the Committee decided to des centralize the presentation of major honors and award- to various general Society and special meetings throughout the year. This recommendation was approved by the Board on Honors and the Council.

In addition, two special awards were approved in a plan to encourage wide local participation in celebrating the 75th Anniversary of the Society. These were the 75th Anniversary Medal, to be awarded "to that member in each ASME section who had done the most to further the aims and objects of the Society"; and the 75th Anniversary Student Award, to be conferred on "the outstanding engineering student" on each campus at which there was a student branch of ASME. At the close of the Society year on Sept. 30, 1955, the 75th Anniversary Medal had already been awarded in 74 Sections, and 75th Anniversary Student Awards in 119 Student Branches. The conferring of these awards in the Sections and Student Branches was made the occasion of featured local celebrations, and did much to stimulate interest in the Society, not only by members of the engineering profession, but also by those outside the profession.

A special 75th Anniversary Meeting was held at Columbia, Mo., on April 13, 1955, under the joint auspices of the Kansas City and St. Louis Sections, together with

the ASME Student Branches at Kansas State College, the University of Kansas, Missouri School of Mines, Washington University of St. Louis, and the University of Missouri. In addition to the presentation of 75th Anniversary Student Awards, the meeting was the occasion for the presentation of the 1955 Holley Medal to Prof. George J. Hood.

As one of the features of the 75th Anniversary celebration, the Council decided that it would be in keeping to confer the Spirit of St. Louis Medal in 1955, even though it had last been presented in 1954 and was normally conferred not more often than once every three years. The presentation of the 1955 Spirit of St. Louis Medal to Ralph S. Damon, president of Trans World Airlines, and the Spirit of St. Louis Junior Award to John Burton Nichols was made the occasion of a special dinner in St. Louis, Mo., on Sept. 29, 1955.

Special 57th Anniversary Medals were conferred on three other individuals. The first was awarded to Dr. Leroy F. Grant, president of the Engineers' Council for Professional Development. This presentation was made during the Organization Anniversary Meeting at Stevens Institute of Technology, Hoboken, N. J., on April 16, 1955. A 75th Anniversary Medal was conferred on Harold S. Osborne, president of the International Electrotechnical Council, at a special luncheon meeting of the Executive Committee of Council in New York on Oct. 18, 1955. The third of these special 75th Anniversary Medals was conferred on Thorndike Saville, dean of engineering at New York University and president of Engineers Joint Council. This medal was conferred on Dean Saville at the Joint Honors Luncheon of the Annual Meeting of ASME in Chicago on Nov. 17, 1955, at which Dean Saville was the toastmaster.

Silver-plated medallions have been awarded to the special panelists and banquet speakers for the five national meetings during the calendar year 1955.

International Recognition

The 75th Anniversary celebration provided an opportunity to the Society to recognize its international relations. This was accomplished in several ways: First, through the holding of two special conferences; second, by recognizing outstanding foreign engineers with ASME honors; third by awarding special 75th Anniversary Medals to the engineering societies of Western Europe with which ASME had co-operated over many years.

The First International Conference on Air Pollution was held in New York, Mar. 1 and 2, 1955. At this meeting well-know authorities from a number of countries gathered to discuss solutions to the air-pollution problems facing the country. At this meeting an honorary membership in ASME was conferred on Sir Hugh E. Beaver of Great Britain.

In Cambridge, Mass., June 15-17, 1955, immediately preceding the Diamond Jubilee Semi-Annual Meeting of the Society, ASME and The Institution of Mechanical Engineers jointly sponsored an international discussion on combustion. A counterpart of this Combustion Conference was held in London, Oct. 25-28, 1955. The discussion at both the Cambridge and London conferences will be brought together. At the Combustion Conference in Cambridge an honorary membership in ASME was conferred on Percy L. Jones, president of The Institution of Mechanical Engineers.

In addition to these two conferences and two honorary memberships conferred there, the Council authorized the bestowal of a number of additional honorary memberships, several of which were awarded to outstanding foreign engineers. In selecting engineers from abroad to honor, it was natural that they would include the heads of certain joint international bodies. These included Sir Vincent de Ferranti, chairman of the World Power Conference, Hilding V. Törnebohm, president of the International Organization for Standardization, and Georg F. C. Dithmer, chairman of the Conference of Engineering Societies of Western Europe and the United States. The first two of these were conferred at the Semi-Annual Meeting. The latter was conferred at a special reception held in the American Embassy in Copenhagen, Denmark, on Sept. 6, 1955, during the meeting of the Conference of Engineering Societies of Western Europe and the United States. In addition to conferring the honorary membership on Mr. Dithmer, special 75th Anniversary Medals were awarded to the engineering societies of Western Europe who were members of the Conference. The intimate relations of ASME with The Engineering Institute of Canada were also recognized by a similar bestowal of honorary membership on their president, Richard E. Heartz. Other honorary memberships were conferred on Jacob Ackeret of Switzerland, and Ernest F. Mercier of France.

Other Honors

In addition to the many honors previously mentioned, the Council, on recommendation of the 75th Anniversary Committee and the Board on Honors, voted to confer honorary membership in ASME on Messrs. Armitage, Doolittle, Earle, Hoyt, Rosen, Sporn, and Williams. These were conferred at the Annual Meeting in Chicago.[4]

Motion Picture

One of the purposes of the 75th Anniversary celebration was to provide a base for broader public-relations activities and thus bring a greater awareness to the general public of the importance of mechanical engineering and the role that ASME plays. After some study the Committee proposed to Council, and Council voted authorization for the preparation of a thirty-minute motion picture, designed for general distribution, to explain the role of mechanical engineering in our economy.[5]

Publicity

A special Diamond Jubilee Book of Facts was prepared to facilitate the preparation of advertising copy, speeches, editorials, and other general publicity material. The Book of Facts contained: (1) a summary of essential facts about ASME; (2) a text section consisting of sixteen chapters covering a brief history of the Society, what the mechanical engineer is, what he does, a story on ASME's codes, a story on standards, another on research, information concerning the Society's co-operation with other societies, both at home and abroad, and other suitable editorial material; (3) a section containing brief biographical information on ASME past-presidents and living present and former officers, and on Honorary

[4] A complete list of honors and awards conferred during the 75th Anniversary will be found on pages 1113–1143 of this issue.

[5] For a brief résumé of the motion picture see pages 1108–1110 of this issue.

Members of ASME; plus a listing, with the citations, for the ASME medallists, ASME George Westinghouse Gold medallists, the Holley medallists, and the Spirit of St. Louis medallists; and (4) a copy of ASME's first catalog—the listing of the Society's membership as of September, 1880.

This book was mailed, with a covering letter from the chairman of the committee, together with four sample radio and TV announcements, a listing of various materials that were available, and suggestions to guide various organizations in their participation in ASME's anniversary, to the heads of about 1500 industrial corporations, to the technical-press editors, to the heads of the engineering colleges of the United States and Canada, to about 45 engineering societies, to 108 leading advertising agencies, to major city newspapers, to the chairmen of ASME Sections, to the faculty advisers of ASME Student Branches, to the chairmen of the professional divisions, to the members of ASME's Council, and to the members of the ASME staff. Publicity releases throughout the year stressed the Society's 75th Anniversary.

Other Features of the Celebration

In addition to the foregoing, a number of miscellaneous items are worthy of mention. Efforts to obtain approval by the Post Office Department for the issuance of a stamp to commemorate the 75th Anniversary were commenced in 1954 and continued throughout the Anniversary Year.

A special design was developed for use as a cancellation slug in postage meters. A copy of this design was made available with the Book of Facts to industry, and we understand from the manufacturers that a number of postage-meter users ordered these special cancellations. It was used regularly in all of the Society's mailings during 1955. The design was also used to decorate programs for the national meetings and division conferences throughout the year.

The Society's letterheads were redesigned and a symbol or replica of the Diamond Jubilee Medallion was included. The redesigned letterheads without the Anniversary Symbol will be continued in use.

Embossed seals were prepared and distributed to the Sections for their use on correspondence. These seals were also made available for general use by the membership and by industry. The manufacturers of the seals report a substantial number of orders from various companies were received.

As another medium of publicity, the 75th Anniversary of the Society was highlighted in the exhibit prepared for the ASME booth at the Chicago Exposition of Power and Mechanical Engineering (Power Show) held concurrently with the Diamond Jubilee Annual Meeting in Chicago, Nov. 14–18, 1955.[6]

An exhibit was prepared for the ASME booth at the Machine Tool Show,[7] Sept. 6–17, 1955, in Chicago. This exhibit featured the relationship between ASME and the machine-tool industry from Fred W. Taylor's "Art of Cutting Metals," presented before the Society in 1906, to the current "Metals Engineering Handbook." It emphasized also the dimensional and other standards of ASME that are of interest to the machine-tool industry.

[6] See special section, MECHANICAL ENGINEERING, vol. 77, no. 11, November, 1955.

[7] See special section, MECHANICAL ENGINEERING, vol. 77, no. 11, November, 1955.

Committee Organization

In 1953, with the impending approach of the Society's 75th Anniversary, the Board on Technology organized a special 75th Anniversary Committee and charged it with the responsibility of developing a committee organization and selecting personnel which would assure proper organization, co-ordination, and conduct of the various meetings to be held in 1955 to commemorate the Society's 75th Anniversary. The initial committee appointed by the Board consisted of Jess H. Davis, chairman, representing the Meetings Committee; and Messrs. Otto de Lorenzi, representing the Publications Committee; E. W. Jacobson, representing the Professional Divisions Committee; R. B. Smith, representing the Board on Technology; and A. C. Pasini, director-at-large, assigned to the Board on Technology. During the Annual Meeting in 1953 the Committee was directed to report direct to Council and the Executive Committee rather than to the Board on Technology.

At its initial meeting held in Rochester in October, 1953, the Committee decided to recommend as a policy that the celebration of the Anniversary in 1955 be spread throughout the entire year and through all the agencies of the Society—the Sections, the Student Branches, the Professional Divisions, and the various administrative, research, codes and standards, and other committees. This was quite different from the one grand week-long celebration in 1930 commemorating the Society's 50th Anniversary.

At this first meeting of the Committee it was recognized that such a celebration was a major public-relations undertaking. Accordingly, the first action of the Committee was to recommend to the Secretary that professional public-relations counsel be obtained immediately.

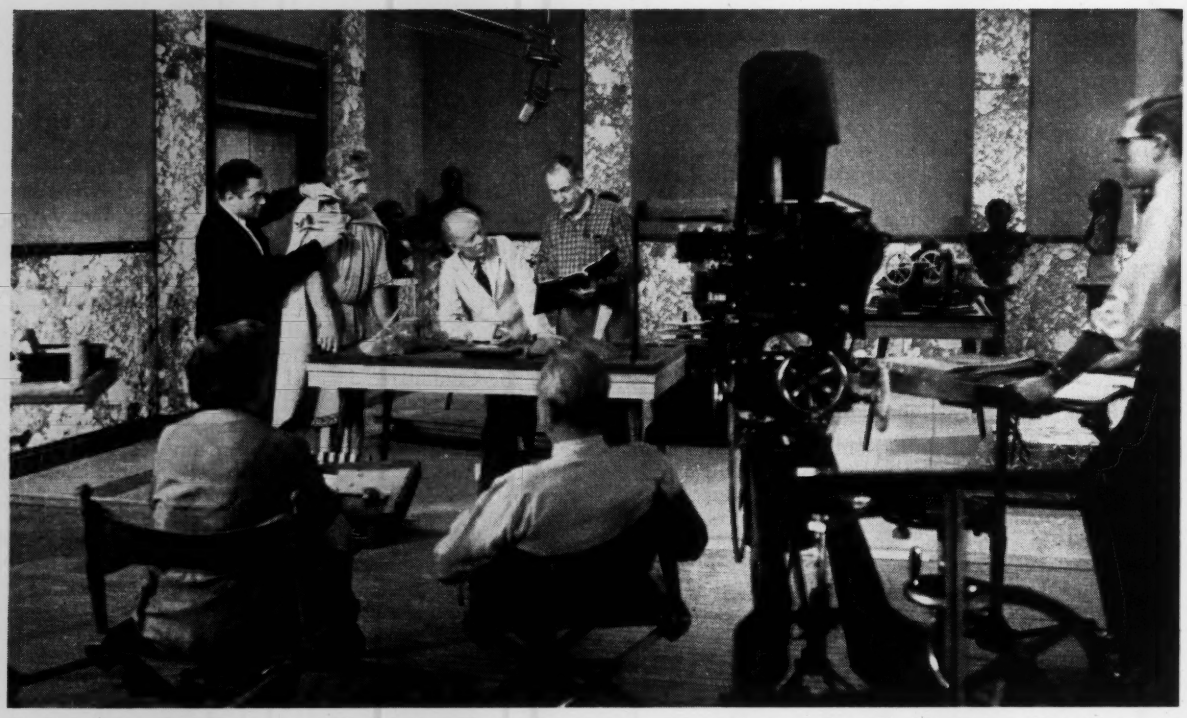
By the end of 1953 the Society's Council had decided to engage the services of Ketchum, MacLeod & Grove, Inc., of Pittsburgh, as public-relations counsel to the Society, with the major project for two years of developing the public-relations effort in connection with the 75th Anniversary celebration. Shortly after this, arrangements were made for the addition of T. A. Marshall, Jr., at that time secretary of Engineers Joint Council and executive secretary of its Engineering Manpower Commission, to join the staff of ASME in April, 1954, with primary responsibility for managing the 75th Anniversary.

In the interim, during the Annual Meeting in 1953, the Society's Council recognized that the 75th Anniversary—if it were to successfully accomplish the breadth of celebration recommended by the 75th Anniversary Committee—would need to be an activity of the Council and its Executive Committee rather than a function of one of the Boards. Accordingly, the Council directed the 75th Anniversary Committee to report directly to the Council rather than to the Board on Technology.

Proceedings

A transcript was made of the panel discussions and major speeches of the 75th Anniversary celebration in the five national meetings during the year. The Committee is planning to publish an edited compendium of these proceedings, to be made available to libraries, educational institutions, and to the membership of the Society at a nominal cost.

"To Enrich Mankind"



On location during filming of ASME Motion Picture, "To Enrich Mankind," finds director Wally Fox, *right*, explaining role of Gus to Larry Bolton as make-up man, *left*, adjusts cape of Gregory Morton who plays Archimedes.

First ASME Motion Picture . . .

. . . explains to the public the significance of the role mechanical engineering plays in the development of our country

In planning the celebration of the 75th Anniversary of the ASME, the 75th Anniversary Committee recognized the lack of understanding on the part of the general public as to what the engineer—particularly the mechanical engineer—and his work, mean to them. In an effort to bring to the "man-on-the-street" a better understanding of what mechanical engineering and the work of the mechanical engineer mean to him, the Committee decided that a motion picture would be one of the most useful means of accomplishing this purpose. When Council approved this recommendation of the 75th Anniversary Committee, the Jam Handy Organization, Inc., of Detroit, Mich., well-known producers of commercial motion pictures, was engaged to produce such a film in 16-mm color by Kodachrome.

The picture was almost a year in the making and has a running time of 25 minutes. It is believed to be the first such picture made by any of the major professional scientific societies. The first print was delivered to ASME on September 2 and flown to Copenhagen where it was shown to the Conference of Engineering Societies of Western Europe and the United States (EUSEC) at a special reception in the U. S. Embassy.

Leading parts are played by Gregory Morton, radio, television, and screen star, who has just completed a feature assignment in the new Hollywood production of "Vagabond King," and Larry Bolton, veteran actor, producer, and director. Wally Fox directed the picture and the script was written by Frank Murray.

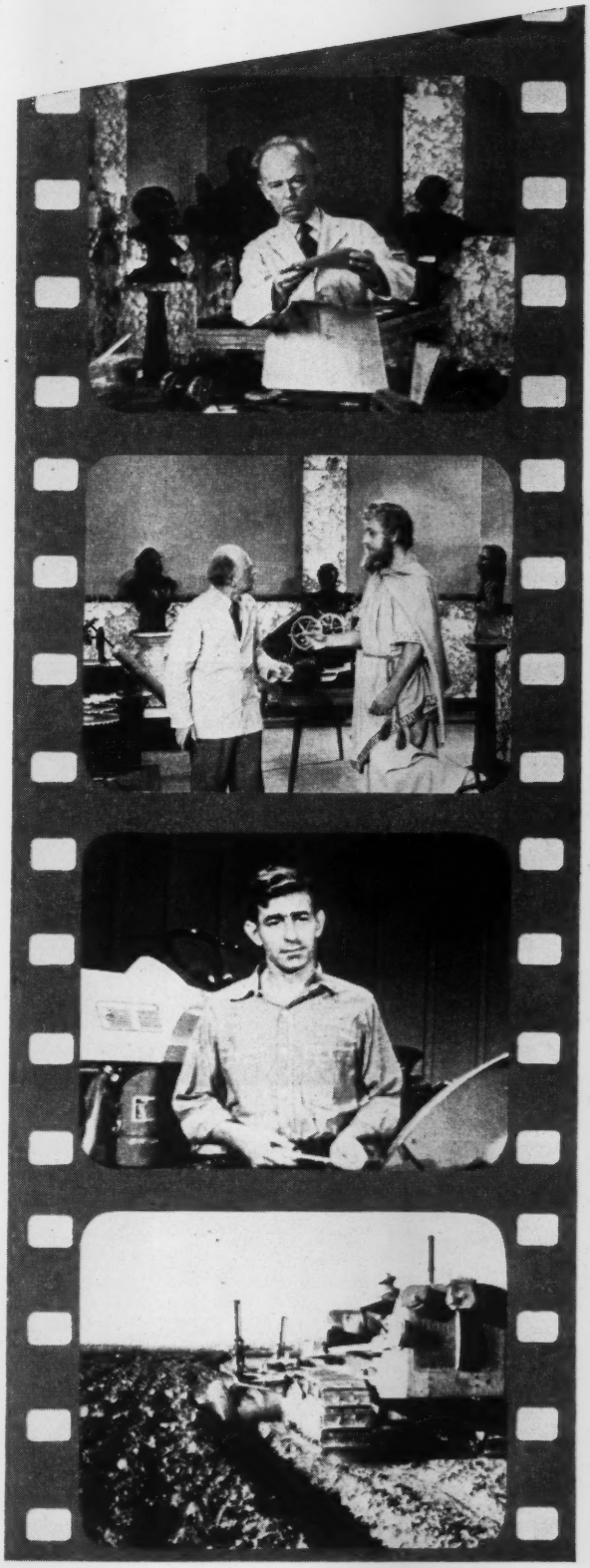
Purpose and Use

While its primary purpose is to explain to the public the significance of the role mechanical engineering plays

in the development of our country, it will also be useful for showing to high-school students and their parents, as a guidance aid, and to college-freshman orientation groups. Arrangements are being made to distribute the picture for television viewings and showings by nonprofit and educational organizations. Prints are being sold to industry.

The story begins in the national museum. Through the wisdom of Archimedes, the famous Greek mathematician and inventor, played by Mr. Morton, Gus, an old-time worker at the museum, played by Mr. Bolton, learns about the important role mechanical engineering plays in our economy.

Gus has been requested by the curator of the museum's division of engineering, to move some machine models from one wing of the building to the other, because of the impending visit of a mechanical engineer and a group of high-school students. Reluctantly he moves the machine exhibits to a display room where there are busts of famous scientists and inventors. In a disgruntled manner, Gus expresses his opinion about mechanical engineering and its relative significance (or insignificance) to society. The statue of Archimedes suddenly comes to life and the eminent Greek inventor proceeds to tell Gus the "ins and outs" of mechanical engineering in a simplified way.



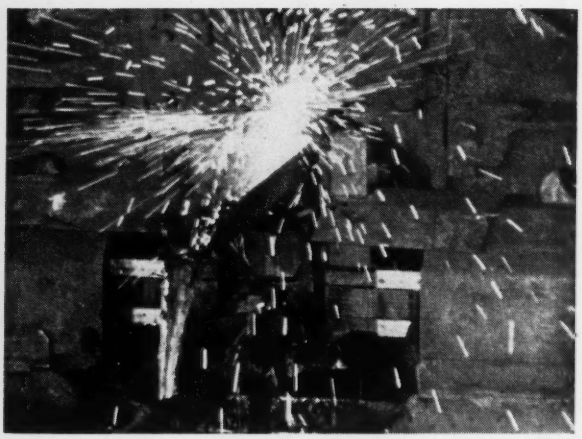
Basic Mechanical Devices

Archimedes emphasizes that every designer today uses various combinations of the six basic mechanical devices: the lever, screw, wheel and axle, inclined plane, and wedge. As he begins to arouse Gus's interest, Archimedes fades out of the scene and different people emerge, showing in his and her own way, how mechanical engineering has become an important factor in everyday living. In addition to showing the benefits the mechanical-engineering profession has brought to our economy and the individuals in it, a mechanical engineer enters the scene to give some concept of the mechanical engineer himself—what he does, and what kind of a person he is.

Machines Create Jobs

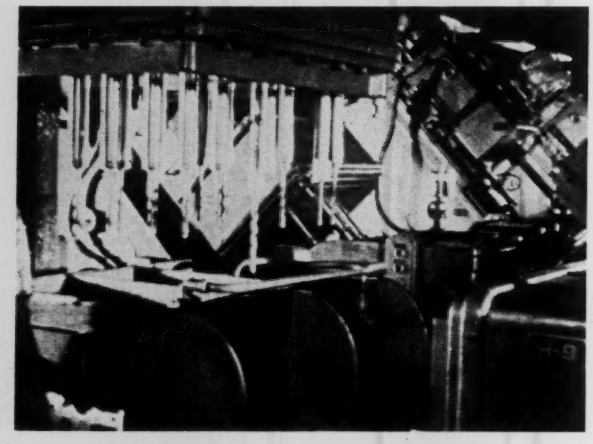
After this thorough and enlightening orientation by Archimedes, Gus wonders if all these machines will not result in putting people out of work. Archimedes points out to him that . . . "machines create jobs. Throughout the years new machines always have meant newer and greater opportunities for people and more people are at work because of them." He then proceeds to give examples from the Conestoga wagon and cotton gin to the harnessing of atomic energy.

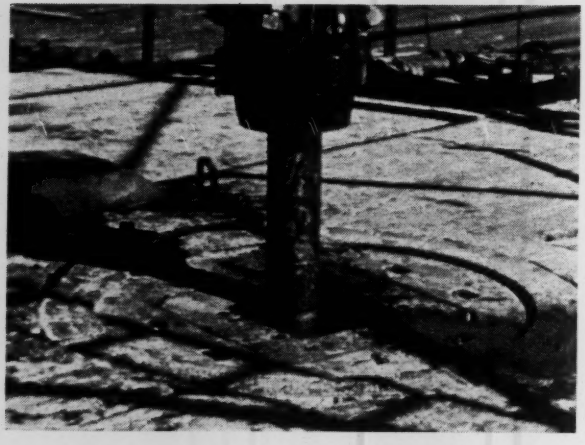
The satisfied Gus realizes now how essential the mechanical engineer is in our world today. As he leaves the room, he pauses and then reflects a bit—Archimedes was right when he said that a mechanical engineer must have . . . "creative imagination—a burning interest in science and mathematics—a large order of ingenuity and a never-ending curiosity." He recalls also Archimedes' final statement—"the rapid progress in the past 75 years is a direct result of engineers sharing knowledge with each other, and it is through organizations like The American Society of Mechanical Engineers that the accumulated knowledge and experience of many individuals have been spread throughout the profession of mechanical engineering—TO ENRICH MANKIND."

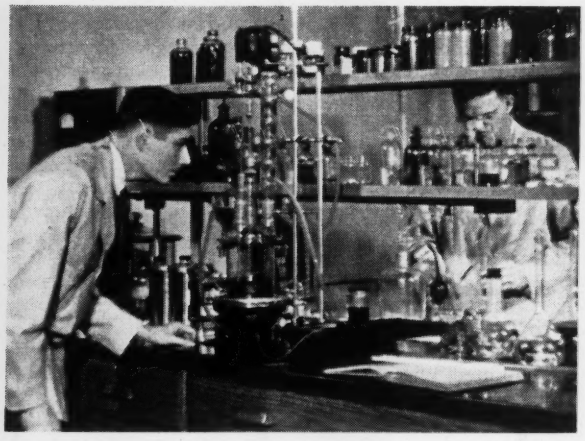


Random scenes from

"To Enrich Mankind"—first ASME motion picture







The Nuclear Engineering Division

ASME assumes ranking position in fostering development of nuclear power

By A. C. Pasini[1]

Chairman, ASME Nuclear Engineering Division

THE HUMAN race has progressed because people have learned to master the forces of the universe. The use of heat energy has enabled us to be in the forefront in world progress.

In 1905 Albert Einstein published his "General Theory of Relativity." In this work he postulated the relationship between mass and energy. The famous equation of energy which equals mass times the velocity of light squared ($E = mc^2$) was enunciated for the first time. The significance was recognized by very few people. In the late 1930's research and experiments indicated that the energy locked in the atom could be added to other energy sources available to man. The world situation precluded the first use of atomic energy for peaceful purposes and all the work was directed toward the military use of this new form of energy.

Nuclear Energy Application Committee Appointed

Since World War II, and even before, thoughtful men were speculating on how this new form of energy could be used for the advancement of mankind. Less than six months after Hiroshima The American Society of Mechanical Engineers organized the Nuclear Energy Application Committee. This date is important because it shows the alertness of the Society to scientific advancements related to engineering. The original committee was composed of Alex D. Bailey, chairman, Albert L. Baker, Capt. J. B. Cochran, G. B. Pegram, Admiral T. A. Solberg, A. R. Stevenson, Jr., and Gen. W. I. Westervelt. Later the committee membership was expanded with Walker Cisler as the chairman. Some of these men were active in the field of nuclear science long before our weapons program was undertaken in 1942. These men were all aware of the future peacetime application of nuclear energy.

The function of the committee was "to stimulate and develop a continuing program of Society activity dealing with the application of nuclear energy." The committee through the years has done just that and has directed its activities constructively.

The committee recognized the need of close co-operation with the Atomic Energy Commission and others directly engaged in developing this new science.

A Planning Subcommittee was organized in March, 1946, to consider the formulation of a Safety Code, Materials Testing Code, and other basic needs. These were discussed at length with AEC, and scientific and other technical societies.

Perhaps its outstanding activity was the glossary, a compilation of terminology applicable to nuclear science and engineering. The glossary consists of nine sections each related to areas of scientific activity. The final sections were published in 1953. All nine sections in a single binder can be obtained from the Society. This was a large undertaking. The National Research Council organization and competent people were included in the effort. The terms and definitions were reviewed and approved jointly by AEC and many individual authorities to insure the greatest possible accuracy. Dean J. R. Dunning and the late Albert L. Baker were the leaders in projecting this work to a successful conclusion.

The committee sponsored many sessions on atomic energy at ASME national meetings, the first one being held in Detroit in June, 1946.

EJC Serves as Co-Ordinator

The rapid progress which has been made in the development of peacetime applications of nuclear science, and the widespread interest which has been brought about by the participation of more and more industries, universities, colleges, and governmental laboratories, clearly indicated the need for a more thoroughly organized program on the part of the Society. In August, 1954, the Engineers Joint Council announced a co-operative program intended to co-ordinate the programs and reconcile the interests of its member societies and others that might wish to participate. It also was apparent that ASME members were becoming more and more interested in the long-range plans of the Society in the field of nuclear engineering. Other problems, such as co-operation with ASME Professional Divisions, paper reviews, and program making, became magnified with the advent of the EJC proposal.

The ASME Board on Technology considered the subject of nuclear engineering and related matters. After considerable debate the Board authorized the formation of a task force to study all related matters in the field of nuclear engineering which affected the Society. The task force was specifically asked to develop ways and means to effectuate co-operation with the EJC proposal and also to study long-range needs in the field of nuclear engineering, recommending a method of organization, and perhaps to set up programs at the national level. It further proposed that the chairman of this task force act as co-ordinator for the Society in the field of nuclear engineering.

Board on Technology Acts for Society

The task force met for the first time on September 15, 1954. This task force was to be known as the Nuclear

[1] Assistant General Superintendent, The Detroit Edison Company, Detroit, Mich. Member and former Vice-President ASME.

Engineering Committee of the Board on Technology. The committee was primarily composed of chairmen of professional divisions believed to have primary interests in the field of nuclear engineering. The committee was composed of R. H. Tingey, W. L. Fleischmann, Hendley Blackmon, R. H. Engdahl, H. B. Nottage, T. R. Olive, Harvey Wagner, R. W. Hartwell, T. A. Marshall, Jr., and A. C. Pasini, chairman. The committee explored the possibilities and implications of the problem as it affected the Society. The recommendations to the Board on Technology were as follows:

1 That EJC would perform a valuable function in bringing together the participating societies in conferences on atomic energy. ASME would welcome the opportunity to participate.

2 The field of nuclear engineering is of sufficient importance to require an organization with professional-division status.

3 The division should be known as the Nuclear Engineering Division of the Society. Its area would be in the field of mechanical engineering in which a knowledge of nuclear physics is essential. The field should embrace such activities as core design, shielding, waste handling, fuels and fuel fabrication, radiation effect, special equipment, and operation of nuclear-energy power plants.

New Division Established

On November 12, 1954, the task force formally petitioned the Professional Divisions Committee for the formation of a Nuclear Engineering Division. Further, because of the great work of the Nuclear Energy Application Committee from 1946 to date, a probationary period would not be necessary. On November 28, 1955, the ASME Council voted unanimously to establish a professional division of nuclear engineering in the Society.

The Executive Committee of the ASME Nuclear Engineering Division, approved by the Organization Committee and the Council, is as follows: A. C. Pasini, *chairman* (1955), Alex D. Bailey (1955), T. A. Solberg (1956), B. R. Prentice (1957), W. E. Shoupp (1958), J. R. Menke (1959), and R. C. Dalzell, secretary (1960).

The Executive Committee held its first meeting on March 29, 1955. Plans were laid for the formation of subcommittees, for participation in the EJC Nuclear Engineering and Science Congress to be held in Cleveland, Ohio, December 12–16, 1955, and for program making within the Society.

All of the members of Nuclear Energy Application Committee have been appointed either as members of the Executive Committee or as advisers to the new Division. In this manner continuity and transition has been effectuated.

The Subcommittees on Division Development, By-laws, Program Making, and Papers Review are actively engaged in the formulation of plans for the future. Active co-operation with other Professional Divisions is one of the fundamental concepts of the Nuclear Engineering Division. Participation in research, standardization, safety codes, air pollution, and other activities as they affect the field of nuclear engineering are but a few of the activities of the Division in the immediate future.

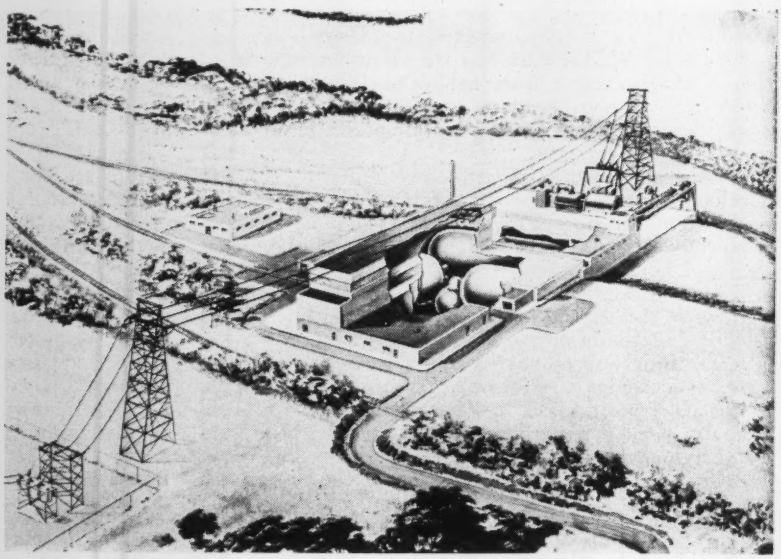
The passage of the Atomic Energy Act of 1954 afforded private industry a larger role in the development of nuclear energy.

Long-Range Plans

The long-range plans of the Division will be directed to the development of the peaceful uses of this new field of engineering.

It also will be the goal of the Division through meetings, forums, and conferences to keep the Society and its members abreast with advances in nuclear engineering as it affects the Society and its members.

The new division has made a good start, thanks to the efforts and previous work of Alex D. Bailey, Walker Cisler, Dr. John R. Dunning, Admiral T. A. Solberg, Gen. W. I. Westervelt, the late Albert L. Baker, and many others who served on the Nuclear Energy Application Committee and who are now active in the work of the new Nuclear Engineering Division.



New artist's sketch of the United States' first full-scale atomic power plant for the generation of electricity. Westinghouse Electric Corporation is developing and building the reactor portion of the plant under contract with the Atomic Energy Commission. Duquesne Light Company of Pittsburgh will build the electric generating portion of the plant and will operate the entire plant after its completion. The cutaway building in the sketch shows the location of the atomic switchyard containing transformers and circuit breakers, and the transmission lines. The atomic reactor which provides the heat, and the heat exchangers which generate the steam, will be located underground in concrete and steel structures. This revolutionary power plant will be delivering electricity to homes and industry in the Pittsburgh area in 1957.

ASME Honors Outstanding Engineers During Diamond Jubilee Year

- *Honorary Members*
- *Joint Engineering Awards*
- *ASME Honors and Awards*
- *75th Anniversary Awards*

DURING the Diamond Jubilee year of the ASME, awards and honors were conferred at the major national Society meetings and special commemorative events arranged by the Sections and Student Branches. Thus recognition of meritorious contributions to the Society, to the profession, and to the community was in a truly national vein.

The conferring of Honorary Membership in the Society, Joint Engineering Societies Awards, ASME Awards and Honors, and special certificates was carried out in line with the plans for celebrating the Society's 75th Anniversary throughout the year rather than at a single meeting.

The Board on Honors established a special 75th Anniversary Medal—one for presentation in the Sections to the member of the Section who had done the most to further the aims and objectives of ASME; and one to be presented to the outstanding engineering student at each college at which there is a Student Branch of ASME.

Honorary Members

Honorary membership in ASME, which was the Society's initial form of award, has throughout the years remained the Society's highest honor. It is conferred upon distinguished persons in engineering, science, industry, research, public service, and allied pursuits.

Basis for awarding honorary membership is "effective and faithful service rendered to the Society, to the engineering profession, or to the public." The character and scope of the service rendered are the predominant criteria rather than strictly engineering or scientific attainments. Hence the honor is distributed widely in all phases of life enhanced by the skill, leadership, and experience of engineers and those with whom they work and associate.

The first honorary member, Horatio Allen, was elected in 1880, the year of the Society's founding. Three of the founders of the Society—Alexander Lyman Holley, John Edson Sweet, and Henry R. Worthington—were elected honorary members in perpetuity.

Honorary membership in ASME gains added prestige because engineers throughout the world are eligible. At the same time the award serves to emphasize the international implications of modern engineering. Out of the 160 honorary members chosen previously, over one third have been citizens of foreign countries. These include Canada, Great Britain, France, Belgium, Germany, Italy, Hungary, Sweden, Russia, New Zealand, Uruguay, China, and Japan.

Normally, up to five honorary members may be named each year. Nominations are made through the ASME Medals Committee, and elections are approved by unanimous vote of the Council.

Jacob Ackeret

Prof. Jacob Ackeret of the Federal Institute of Technology, Zurich, Switzerland, has made outstanding contributions in the field of aerodynamics with special reference to linear supersonic theory, and in the field of mechanical engineering through his wide research on lifting surfaces, compressors, gas turbines, and other fluid machinery.

Working in the tradition of the noted Prof. Aurel Stodola, whom he assisted at the Federal Technical Institute from 1920 to 1921, Professor Ackeret has done special study on boundary-layer suction since 1924, conducted research on supersonic airfoils in 1925, and designed and constructed the first supersonic closed variable-density wind tunnel in 1934. In conjunction with Escher Wyss and Dr. Keller he developed a closed-cycle gas turbine (1936). Other projects have included a variable-pitch propeller for aircraft and ships and research on cascade theory, scale effects, and rocket theory.

"Cavitation" was the subject of his doctoral thesis at Zurich, and he is the author of numerous publications on a variety of technical topics.

Born in Zurich in 1898, he received his diploma from the Federal Technical

Jacob Ackeret

Joseph B. Armitage

Institute in 1920. From 1921 to 1927 he was assistant to Professor Prandtl in Göttingen, Germany, and chief of section at the Kaiser Wilhelm Institute for Fluid Mechanics. Returning to Zurich in 1927, he became chief engineer (hydraulics) for Escher Wyss & Company and assistant professor of aerodynamics at the Federal Institute of Technology. Appointed extraordinary professor in 1931, he has since then devoted the major part of his time to the Institute, becoming full professor in 1934.

He is an honorary Fellow of the Institute of Aeronautical Sciences (New York), an honorary member of the Italian Association for Aeronautical Engineering, and a member of the Max Planck Institute for Fluid Mechanics (Göttingen) and the Academy of Turin, Italy. The Technical Institute of Vienna awarded him an honorary doctorate in technical sciences in 1952.

Professor Ackeret was chairman of the Fourth International Congress of Aeronautics in Zurich in 1953, and has served on committees for several international congresses of applied mechanics.

Joseph B. Armitage

Joseph B. Armitage, vice-president in charge of engineering at Kearney & Trecker Corporation, Milwaukee, Wis., has been a Fellow, Director at Large, and an active committee member of the ASME since his election to membership in 1919.

Born at Hyde, Cheshire, England, in 1881, Mr. Armitage was educated in England and at Rhode Island College. He became an assistant designer of milling machines at Brown & Sharpe Manufacturing Company in Providence, R. I., and, subsequently, machine designer at The Taft-Peirce Manufacturing Company, Woonsocket, R. I., and chief draftsman at Narragansett Machine Company in Pawtucket, R. I.

During World War I Mr. Armitage joined the Aluminum Casting Company of Cleveland, Ohio, to take charge of the mechanical section of the lynite laboratories. This company made all of the aluminum castings for the famous Liberty engine.

In 1920 he joined the staff of Kearney & Trecker Corporation as chief engineer, and was appointed to his present position as vice-president in 1943. During this time he has personally brought about many of the major changes in the past quarter of a century in milling-machine design, and has been in large measure responsible for the design and development of the entire Milwaukee line of machine tools as it exists today. A good measure of his accomplishments is the fact that during the period in which he served Kearney & Trecker his company has become one of the two largest milling-machine manufacturers in the world, and his company's products have won world-wide acclaim and acceptance.

A Director at Large of ASME from 1947 to 1950, Mr. Armitage was also vice-president of the Society of Automotive Engineers in 1948. He has served on some ten committees of our Society, chiefly in the field of machine-tool standardization, and also as a member of the Committee on Splines of the American Gear Manufacturers Association.

In addition to his memberships in ASME and SAE, Mr. Armitage holds membership in the Newcomen Society and the Milwaukee Engineering Society. He holds numerous patents and is the author of many technical papers in the machine-design field.

Sir Hugh E. C. Beaver

Detlev W. Bronk

Sir Hugh E. C. Beaver

Sir Hugh E. C. Beaver is managing director of Arthur Guinness, Son & Co., Ltd., London, England, and has held many responsible appointments aiding the government. He was made an Honorary Member of the ASME at a banquet session held at the Hotel Statler, New York, N. Y., in conjunction with the first ASME International Congress on Air Pollution, March 1, 1955. At this Congress he delivered the annual Calvin W. Rice Lecture of the ASME.

He currently serves as chairman of Great Britain's Committee of Enquiry to Examine the Nature, Causes, and Effects of Air Pollution, which early in 1955 submitted a final report on the 1952 four-day London smog. The 1952 episode, which began on December 5, killed an estimated 4000 Londoners and sickened and distressed many more. The full significance of this catastrophe was not immediately realized and Sir Hugh's committee was not appointed until July, 1953.

The final report formed the basis of the lecture Sir Hugh delivered and was entitled, "Air Pollution—The Growth of Public Opinion," and traced the history of air-pollution reform in Great Britain.

Educated in England's Wellington College, Sir Hugh has had a long career in both private business and in government service. He served as director general and controller general for the Ministry of Works from 1940 to 1945. For two years thereafter he was a member of Lord Reith's Committee on New Towns. From 1948 to 1950 he was a member of the Building Industry Working Party.

King George VI knighted Sir Hugh in 1943.

Sir Hugh is a Fellow of the Royal Economic Society, Royal Statistical Society, and the Royal Society of Antiquaries of Ireland. He is also a member of The Institution of Civil Engineers; Institution of Chemical Engineers; Engineering Institute of Canada; British Institute of Management; Court of Governors of the London School of Economics; British Institute of Archaeology, Ankara; Advisory Council of D.S.I.R.; and the General Middlesex Cp. Hospital Management Committee.

He serves as chairman of the Shoreditch, Hackney, and Highbury Housing Association; as governor and honorary treasurer of Wellington College; and as a director of The Colonial Development Corporation.

The Calvin W. Rice Lecture was awarded Sir Hugh by the ASME in recognition of his many outstanding achievements in the engineering field. Created to honor the man who was ASME Secretary from 1906 to 1934 and to further his ideals to increase understanding between the engineers of the various countries and to broaden the programs of Society meetings, the lec-

ture has been awarded to distinguished engineers each year since 1934.

Detlev W. Bronk

The scientific achievement of Detlev W. Bronk is reflected in the important positions he now holds as president of the Rockefeller Institute for Medical Research and president of the National Academy of Sciences. The wide scope of his activities has ranged from physics and atomic energy to marine biology and physiology.

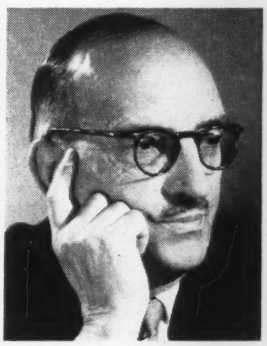
After receiving a BA degree from Swarthmore College in 1920, he was employed as assistant power engineer by the Philadelphia Electric Company. In 1921 he was instructor in physics at the University of Pennsylvania. The following year he began a similar appointment at the University of Michigan and received an MS degree. Branching out to include research in physiology, he was awarded a PhD degree by the University of Michigan in 1926.

Dr. Bronk was on the faculty at Swarthmore from 1926 to 1929, rising to the rank of full professor and also serving for a year as dean of men. During the latter year he studied in Cambridge and London, England, as a fellow of the National Research Council. He was associated with the University of Pennsylvania from 1929 to 1949 as director of the Johnson Research Foundation for Medical Physics and director of the Institute for Neurology (1936–1940). During 1940–1941 he was professor of physiology at Cornell Medical College, and from 1942 to 1946 acted as co-ordinator of research for the Air Surgeon's Office of the Army.

In 1948 Dr. Bronk was named president of The Johns Hopkins University, administering that office until his resignation in 1953 to become president of the Rockefeller Institute. Throughout his career he has delivered lectures before a number of colleges and has also edited various scientific journals.

He served previously as foreign secretary of the National Academy of Sciences and chairman of its National Research Council (1946–1951). Currently he is vice-chairman of the National Science Board of the National Science Foundation, vice-chairman of the National Advisory Committee for Aeronautics, member of the Science Advisory Committee of the Office of Defense Mobilization, and of the Science Advisory Board to the Air Force Chief of Staff. In 1952 he was president of the American Association for the Advancement of Science.

Vannevar Bush



Sir Vincent de Ferranti

Vannevar Bush

Vannevar Bush, president of the Carnegie Institution of Washington, recognized for his eminent service as engineer and scientist, teacher, and administrator, was made Honorary Member of ASME at the Founding Anniversary Banquet held February 16, 1955, at the Waldorf-Astoria Hotel, New York, N. Y.

The broad scope of his accomplishment in peace and war combined with the brilliant quality of his specialized research has made him internationally famous.

Dr. Bush was born in Everett, Mass., in 1890. He received BS and MS degrees from Tufts College, 1913, and was on the faculty from 1914 to 1916. Harvard University awarded him a doctorate in engineering in 1916. From 1913 to 1914 he worked in the test department of the General Electric Company and also in the inspection department of the U. S. Navy. During World War I he served with a special board of the Navy Department conducting research on submarine detection.

Following the war he was named associate professor of electric-power transmission at the Massachusetts Institute of Technology, becoming a full professor in 1923, and vice-president and dean of engineering in 1932. While at M.I.T. he became well known for his work on differential computers. Dr. Bush has been president of the Carnegie Institution of Washington since 1939.

During World War II he was a key figure in the national defense and served as chairman of many important defense activities during this critical period.

Recipient of the ASME Holley Medal in 1943, Dr. Bush has received numerous honors and degrees from professional societies and institutions of learning both in this country and abroad. Throughout his career he has found time to publish books and articles on many subjects.

A Fellow of the American Physical Society and AIEE, he is also affiliated with ASEE, AAAS, the National Academy of Science, and many other groups. Dr. Bush is a member of the National Advisory Committee for Aeronautics and was its chairman from 1939 to 1941. He is a trustee of The Johns Hopkins University, Tufts College, and the Carnegie Corporation of New York, a life member of the M.I.T. Corporation, and has been a director of AT&T and Merck & Co.

Sir Vincent de Ferranti

As chairman and managing director of Ferranti Ltd., Sir Vincent de Ferranti has been responsible for important developments in electric-power equipment and appliances, has rendered vital assistance to his country in wartime production, and has notably served the engineering profession as chairman since 1950 of the International Executive Council of the World Power Conference.

Upon joining Ferranti Ltd., after service in World War I, Sir Vincent was engaged in experimental work on reversing regenerator engines and boilers. The firm, which is located in Hollinwood, Lancashire, England, was founded in 1882 by his father, Dr. S. Z. de Ferranti, F.R.S. In 1921 he became manager of the transformer department. Named a director of the company in 1924, he made a six months world tour to study conditions in Canada, New Zealand, Australia, and South Africa. In 1926 he opened the New York, N. Y., factory for manufacture of radio components and was also active in reorganization of the company's Canadian facilities in Toronto.

After his father's death in 1930, he became chairman and carried out a program of radio expansion, with the opening in

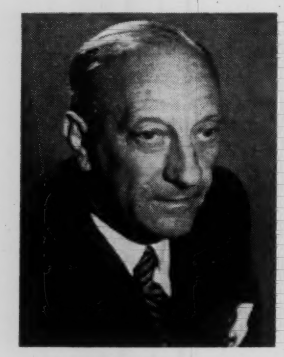
1934 of a large new plant at Moston, Manchester, for the manufacture of radio receivers, cathode-ray tubes and valves, and domestic appliances.

Sir Vincent has seen active service in both World Wars. He was commissioned in the Royal Engineers in 1914 and served in Gallipoli and Salonika, attaining the rank of captain and being awarded the Military Cross. In 1939 he served in France as a major commanding a field company in the Royal Engineers, but after Dunkirk, was recalled to direct personally the wartime activities of Ferranti Ltd. Since 1945 he has been Honorary Colonel of the 123 Field Engineer Regiment.

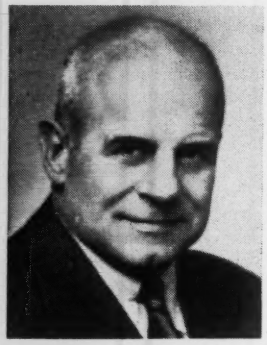
He was born in Chelsea, London, in 1893, and educated at Repton School, where he won the science prize. During an apprenticeship with Yarrow of Scotstoun he helped build destroyers for the Royal Navy.

In 1946 he became president of The Institution of Electrical Engineers, an office once held by his father.

King George VI bestowed knighthood upon him in 1948.



Georg F. C. Dithmer



James H. Doolittle

Georg F. C. Dithmer

Georg F. C. Dithmer, eminent Danish mechanical engineer, shipbuilder, and manager, was made Honorary Member of The American Society of Mechanical Engineers in Copenhagen, Denmark, on September 6, 1955, during a brief, informal ceremony in the American Embassy.

The ceremony was a high light of the biennial meeting of the Conference of Engineering Societies of Western Europe and the United States (EUSEC). Mr. Dithmer, who served as chairman of EUSEC, is president of the Danish Institution of Civil Engineers.

Mr. Dithmer, a native of Denmark, was born in Bucharest, Romania, of Danish parents. He is a graduate of the Industrischule, Winterthur, Switzerland, and the famed Königliche Technische Hochschule, Charlottenburg, Berlin, Germany.

Soon after graduation, he joined the Burmeister & Wain Shipyard as a mechanical engineer. Prior to his retirement from active duty with that firm in 1952, he had become known throughout the world for his work in mechanical-engineering aspects of shipbuilding and the iron and metalworking industries and for his activities in behalf of the Danish Standards Association and numerous other professional societies and academies. He is still active as technical adviser to the board of directors of Burmeister & Wain and is a director of several other Danish firms.

During his career Mr. Dithmer received honors from many nations. These honors include Denmark's Knight's Cross and the Order of Daneborg, Norway's Order of St. Olav, Iceland's Order of the Falcon, and Belgium's Order of Leopold II.

James H. Doolittle

Lieut. Gen. James H. Doolittle, U.S.A. (ret.), has had a notable career, with unique achievements in three separate and distinct fields—business, aviation, and military service.

He has been vice-president and director of the Shell Oil Company since 1930, when he became manager of aviation for the Shell Petroleum Corporation. Throughout the 1930's he directed the growth of the company's aviation activities, and in 1934 was instrumental in pioneering 100-octane aviation gasoline, which was first produced by Shell.

In the field of aviation General Doolittle holds an impressive number of "firsts." He was the first to fly over 300 miles per hour in a landplane, and the first to do the hazardous outside loop. Being the first to take off, fly a set course, and then land without seeing the ground, he thus was the pioneer in the science of blind flying. In recognition of this achievement he was awarded the Harmon International Aviation Award.

General Doolittle has given meritorious service in two wars. His education at the University of California was interrupted during World War I, when he enlisted as a flying cadet in the aviation section of the U. S. Signal Corps. He remained on active duty until 1930 as an aviator-instructor and aeronautical-engineering officer.

It was during this period that he accomplished many of his noted flying feats and made numerous valuable engineering contributions to aviation. Resigning in 1930, with a reserve commission of Major, he joined Shell. Upon recall to active duty with the U. S. Air Corps in 1940, he helped direct the conversion of the automotive industry to the manufacture of aircraft and component parts.

He led the famous Tokyo raid in April, 1942, for which he received the Congressional Medal of Honor. His commands included the 12th and 15th Air Forces and, on January 1, 1944, he took command of the 8th Air Force, the world's largest and most powerful strategic bombing force. On January 5, 1946, he resigned as a Lieutenant General to rejoin Shell.

Born in Alameda, Calif., in 1896, General Doolittle's childhood was spent in Alaska and California. He holds a BA degree from the University of California, and an MS and PhD in aeronautical engineering from the Massachusetts Institute of Technology. In winning his doctorate in one year after receiving his master's degree, he performed a feat regarded as unique at this institution. His honorary degrees include LLD, University of California; DE, Polytechnic Institute of Brooklyn; DS, Clarkson College of Technology; Doctor of Military Science, Waynesburg College; and LLD, Northland College.

He is a past-president and honorary Fellow of the Institute of the Aeronautical Sciences, a Fellow of the Royal Aeronautical Society, past-chairman of the board and past-president of the Air Force Association, and a member of the National Advisory Committee for Aeronautics. He is a Member of The American Society of Mechanical Engineers and the recipient, in 1938, of the Society's Spirit of St. Louis Medal for exceptional service to aeronautics.

Samuel B. Earle

Richard E. Heartz

Samuel B. Earle

In conferring honorary membership on Samuel Broadus Earle, dean emeritus of the School of Engineering and director of the Engineering Experiment Station at Clemson Agricultural College, the Society pays tribute to a man who has made an important contribution to the engineering profession during a long and distinguished career as an educator.

Dr. Earle was born in Gowensville, S. C., in 1878. He holds the degrees of AB, AM, and LLD from Furman University, and an ME from Cornell University. Becoming an assistant professor of mechanical engineering at Clemson College in 1902, he rose to a full professorship and the post of director of the engineering department in 1910. In 1924 he assumed the additional duties of director of the Engineering Experiment Station at the college. He became dean of the School of Engineering, as well as director of the Engineering Experiment Station in 1933, and held these posts until his retirement in 1950. He has also served on several occasions as acting president of Clemson College.

Dr. Earle is a past-president of the American Society for Engineering Education, 1937–1938, and a past-chairman of the Engineering Section, Association of Land Grant Colleges and Universities. He is a Fellow of the American Association for the Advancement of Science, and an active member of many committees, including the Statewide Committee for Trade Recovery and the Committee of National Engineering Council on Unemployment in South Carolina. He is a member of Chi Psi, Tau Beta Pi, and Phi Kappa Phi.

A Fellow of The American Society of Mechanical Engineers, Dr. Earle has been active in Society affairs since first joining ASME in 1905. He has served as chairman of the Greenville Section of the Society, as a manager from 1937 to 1940, and as a vice-president from 1940 to 1942.

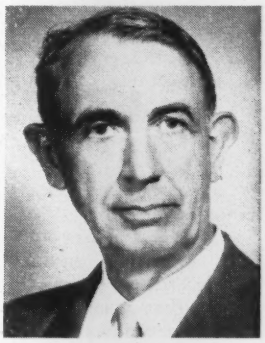
Richard E. Heartz

Richard Edgar Heartz, president of The Engineering Institute of Canada, has been a member of that organization for 38 years. He has served as a member of the council, treasurer, vice-president, and chairman of the Finance Committee. In 1954 he was chairman of the hydraulic-turbine group of the International Electrotechnical Conference in Philadelphia, Pa. He is active in The American Society of Mechanical Engineers and the American Society of Civil Engineers, and is a member of the Corporation of Professional Engineers of Quebec and the Newcomen Society of England.

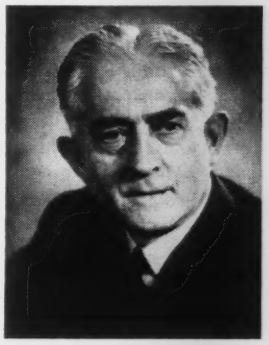
President since 1952 of the Shawinigan Engineering Company, Ltd., of Montreal, Mr. Heartz has for many years played an important role in the remarkable industrial expansion of Canada through the design and construction of hydroelectric developments and related engineering works. His initial assignment with the Shawinigan Engineering Company was as resident engineer in 1920 on the construction of the Shawinigan Water and Power Company's No. 2A development at Shawinigan Falls. In the years following he was resident engineer on construction of such power developments as La Gabelle, St. Narcisse, and Paugan Falls. Later he was transferred to the company's head office in Montreal, being named assistant chief engineer in 1935. In this capacity he made many innovations in methods and equipment. In January, 1947, he was appointed vice-president and chief engineer and a director of the company.

The Canadian Government secured the loan of his services in 1941–1942 as general manager of Wartime Merchant Shipping, Ltd., a Dominion-wide organization which directed the efforts of 14 shipyards and their associated suppliers in implementing the nation's wartime cargo-vessel program. Seventy-five-thousand men were employed at the peak of this activity and over four million tons of shipping were built.

Mr. Heartz served in World War I as an RAF pilot. He was born in 1895 in Marshfield, Prince Edward Island, and was educated at Mount Allison University, Sackville, N. B., and McGill University (BSc in civil engineering, 1917). He received an honorary LLD from Mount Allison University in 1952.



Simes T. Hoyt



Percy L. Jones

Simes T. Hoyt

Honorary membership in the ASME is being conferred on Simes Thurston Hoyt, consulting engineer at Castle & Cooke, Ltd., Honolulu, T. H., in recognition of his outstanding engineering achievements in the pineapple, sugar, and related industries in the Territory of Hawaii.

Mr. Hoyt is a native of Newington, N. H., and received his education at New Hampshire State College (now the University of New Hampshire), which

awarded him a BS in mechanical engineering in 1910. He went to Hawaii a year later to take a position as instructor in science, mathematics, and woodworking at the Territorial Normal School (now a part of the University of Hawaii). After a period as vocational instructor for Honolulu schools, during which time he built new schools and instituted many changes, in 1915 he joined the Hawaiian Pineapple Company. While with this company, he held positions of increasing responsibility, finally becoming advisory engineer to the company. During this period, although there were few major changes in the growing and harvesting of the pineapple, great changes took place in pineapple cannery. Mr. Hoyt was directly connected with these changes, and partially or completely responsible for their development. Among other innovations, he developed and installed new and additional equipment on shredders, centrifugals, filters, and evaporators; brought out the present high-speed Ginaca machine, the slicer, vertical cooler, and numerous other improved canning machines; supervised the installation of roads, water, and power systems on the Island of Lanai; and assisted the Inter Island Steam Navigation Co., Ltd. in the development of equipment for ocean transport of fresh pineapple. With a colleague he built and patented an improved design of cooler for cans of cooked pineapple, and also conducted the first experiments which showed conclusively the very rapid deterioration of canned pineapple at temperature above 100 F. Practically all of these changes were adopted by the other pineapple canneries.

In 1932 Mr. Hoyt became consulting engineer for Castle & Cooke, Ltd., and still holds this position. This company acts as agent for three large sugar plantations, as well as the Matson Navigation Company, which hauls practically all of the raw sugar manufactured in Hawaii to the Mainland. Much of the credit for the satisfactory operation of the sugar plantations belongs to Mr. Hoyt, who, with his versatility as a registered professional, electrical, hydraulic, civil, structural, and mechanical engineer, and his knowledge of the chemistry of raw-sugar manufacture, has been able to solve many difficult problems. Improvements made by Mr. Hoyt have been instituted in other sugar-producing factories throughout the world.

Mr. Hoyt is a member of numerous important committees, and has given unstintingly of his time in public service.

He has been a Member of ASME since 1923. Besides his memberships in the engineering societies, he is also a member of the American Association for the Advancement of Science, National Geographic Society, Hawaiian Sugar Planters' Association, Hawaiian Historical Society, and the Honolulu Chamber of Commerce.

Percy L. Jones

Managing director of the engineering department of Swan, Hunter & Wigham Richardson, Ltd., Percy L. Jones is now president of Britain's Institution of Mechanical Engineers. He has been in charge of all engineering activities for his firm for the past 20 years. Mr. Jones joined the company in 1923 as technical manager of the engineering department. He is a director of Swan, Hunter & Richardson, Ltd., and of the associated firm, The Wallsend Slipway and Engineering Company, Ltd.

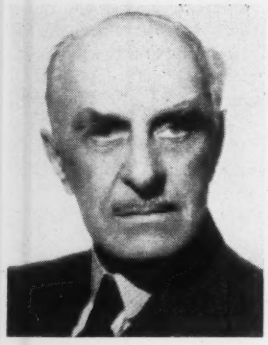
Previously he was chief assistant to Sir Henry Guy of Metropolitan-Vickers Electrical Company. His employment by that concern in 1912 was interrupted by military service during World War I.

At the outbreak of hostilities he enlisted in the infantry and soon afterwards received a commission. Later he became a major and commanded a battery of artillery in France and Flanders. Mr. Jones was awarded the Military Cross in 1916 and a Bar to the Military Cross in 1917.

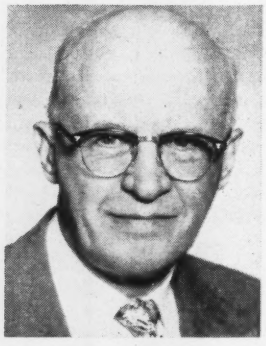
Educated at the Taunton School, he served his apprenticeship at the Locomotive Works of Rhymney Railway Company near Cardiff. Subsequently he entered University College, Cardiff, and was graduated three years later with the degree of BSc Engineering, 1909. He was an assistant lecturer at Liverpool University until his affiliation with Metropolitan-Vickers. In 1938 Mr. Jones delivered the tenth Thomas Lowe Gray Lecture.

He was elected associate member of The Institution of Mechanical Engineers in 1915 and transferred to membership in 1932. From 1939 to 1941 he served as chairman of the North-Eastern Branch, and was elected a member of council in 1942 and vice-president in 1950.

He is president-elect of the North-East Coast Institution of Engineers and Shipbuilders, vice-chairman of the National Association of Marine Engine-builders, a member of The Institution of Civil Engineers, the Society of Naval Architects and Marine Engineers (U. S. A.), the Whitworth Society, and Lloyd's Technical Committee. He is also chairman or member of several committees of the British Shipbuilding Research Association.



Ernest F. Mercier



Carl G. A. Rosen

Ernest F. Mercier

In reviewing the achievements of Ernest Frederic Mercier it is difficult to believe that so many careers could have been successfully crowded into one lifetime. Upon completing his studies at the Polytechnic School in Paris (1899), he spent 13 years as an engineer in the French Navy. Resigning to enter industry, he was not only responsible for organizing and maintaining the power industry in France but also played an important role in the petroleum and mechanical construction fields.

Two World Wars claimed from him ten years of outstanding service. During the past 20 years he headed a number of international professional organizations. In addition, he found time for educational work, as well as research and experimentation in thermodynamics and the gas turbine.

Prior to World War I, Mr. Mercier was chief engineer of the "Triphase" Company and modernized its power plant at Asnieres (Seine). Before leaving the Ministry of Armament after the war he mapped the program for reorganizing the nation's electrical production and distribution. In 1919 he founded the Union d'Electricité, which constructed the

Gennevilliers power plant, the first large interconnecting power system in the Paris area, as well as the Arrighi power plant. His activity in hydroelectric development continued despite the difficulties of World War II and he participated in many other power projects in France and abroad until nationalization of these utilities in 1946.

In 1919 Mr. Mercier founded the French Petroleum Company, of which he was president, and he was also director of the Irak Petroleum Company, London, until the Vichy Government withdrew these appointments. In the mechanical-construction industry he was administrator of the Alsatian Company, the Alsthom Manufacturing Company, and the Penhoet Shipyard and Manufacturing Company.

International organizations he headed included the French National Committee of the World Power Conference, and the French Committee of the International Chamber of Commerce. A native of Constantine, Algeria, in 1878, he received numerous honors and awards in France and abroad for his contributions in war and peace.

Mr. Mercier, who had been a director of the Suez Canal Company, died July 11, 1955.

Carl G. A. Rosen

Carl G. A. Rosen has received wide and creditable acclaim throughout the world of engineering science for his research and development of the diesel engine.

As a boy in San Francisco, Calif., where he was born in 1891, he had watched the sailing ships give way to the diesel ocean liners. For a year after receiving a BS degree from the University of California in 1914, he busied himself by making miniature power-plant models for several companies for showing at the Panama Pacific Exposition in 1915. This experience seemed to fix his objectives and resulted in his immediately launching a career eminent in the field of diesel-engineering development and research.

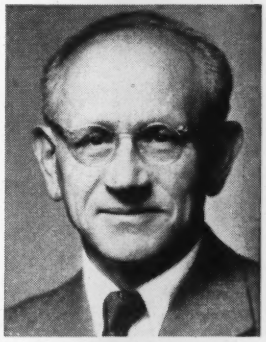
Mr. Rosen's first position was as a draftsman for Dow Pump and Diesel Engine Company. There he rose to the position of chief engineer. While with Dow he pioneered experimental work on replacing the conventional air-injection fuel system with the simpler mechanical-injection method now universally used in diesel engines. He was also responsible for the design and installation of two four-cycle direct-reversible diesel engines for the new vessel, *The Libby Main*, which incorporated many unique features as a forerunner of later American diesel ship-propulsion practice.

In 1928 Caterpillar Tractor Company asked Mr. Rosen to take charge of a program to develop a diesel for tractor application. In 1931 this effort produced the outstandingly successful Caterpillar diesel tractor. Seven years later he moved to Caterpillar's Peoria, Ill., plant, continuing in charge of diesel development and, in 1942, became director of the newly established research department. He is currently consulting engineer to the president of Caterpillar.

Mr. Rosen rendered valuable service during World War II as chairman of the SAE Torsional Vibration Committee, solving problems associated with submarine and surface craft and, during the latter part of the war, as a member of the Navy technical operations.

Also active in education, he is a lecturer in mechanical engineering at Stanford University's Graduate School. He was a Regents Lecturer in mechanical engineering at the University of California in 1954.

Mr. Rosen's interest in encouraging and promoting the interchange of technical knowledge has won him many responsible positions with national and international engineering societies. He is president of the Society of Automotive Engineers and is a Fellow and Life Member of The American Society of Mechanical Engineers, having first joined ASME in 1916. He has been an active member of the American Society for Testing Materials and Co-Ordinating Research Council, and is currently a member of the Technical Advisory Panel, Research and Development Board, U. S. Department of Defense. He is also a member of Sigma Xi and Pi Tau Sigma.



Philip Sporn

Hilding V. Törnebohm

Philip Sporn

Philip Sporn, widely known as an engineer and executive in the electric-utility industry, was born in Austria in 1896, becoming an American citizen through naturalization in 1907. He is a graduate of Columbia University School of Engineering (1917), and holds honorary degrees from Illinois Institute of Technology, Hanover College, Stevens Institute of Technology, Polytechnic Institute of Brooklyn, and the University of Grenoble, France.

Mr. Sporn joined the American Gas and Electric Company in 1920 and subsequently rose through the ranks to become chief engineer of the company and its subsidiaries in 1933. He was elected president in 1947. He has led his company's extensive pioneering work in the fields of electric-power generation, transmission, and distribution, particularly toward the objectives of greater efficiency and economy of operation—striving to extend the use of electric energy in every phase of our society by improving reliability and reducing the cost of electricity despite the constantly increasing cost of virtually every other item of modern-day living.

Mr. Sporn has devoted a great deal of time and effort to the study of nuclear energy, and particularly to the possibilities of its application in the field of power generation. Between 1949 and 1951 he served as chairman of the Ad Hoc Advisory Committee on co-operation between the electric-power industry and the Atomic Energy Commission, set up by the United States Atomic Energy Commission. He is a member of the Visiting Committee for the Nuclear Engineering and Reactor Departments of the Brookhaven National Laboratory. In 1952 he was elected president of the newly formed Ohio Valley Electric Corporation, a $440 million enterprise organized by 15 private electric-utility companies of the Ohio Valley region to supply the electric power

of the Atomic Energy Commission's new $1.25-billion-dollar diffusion plant under construction in Pike County, Ohio. In 1955 he was elected president of Nuclear Power Group, Inc., a nonprofit organization dedicated to the investigation and development of nuclear-power technology. NPG will perform the research and development work for the 180,000-kw boiling-water reactor plant owned and operated by Commonwealth Edison Company and cosponsored by the eight companies which comprise NPG. Mr. Sporn served on the U. S. Delegation to the International Conference on Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, in August, 1955.

During World War II he was a consultant to the War Production Board and later was a member of the Electric Power Committee of the National Security Resources Board.

Mr. Sporn is the author of numerous papers presented before the leading engineering societies. He has contributed extensively to the technical press and is the author and coauthor, respectively, of "The Integrated Power System" and "Heat Pumps."

He is a Fellow of The American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Association for the Advancement of Science, and a member of the American Society of Civil Engineers, The Franklin Institute, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

Hilding V. Törnebohm

Vice-president and technical manager of Svenska Kullagerfabriken (SKF), Gothenburg, Sweden, and president since 1950 of the International Organization for Standardization, Dr. Hilding V. Törnebohm has been in the forefront of the movement for development of standards since 1918.

He has been associated with SKF since 1919, joining the firm as chief draftsman. He has held his present position since 1941.

When standardization was begun in the mechanical industry in Sweden, Dr. Törnebohm helped form a Standards Committee. In 1919 he was able to demonstrate that tolerances could be calculated on a mathematical basis. Subsequently he was instrumental in furthering standardization in the Scandinavian countries and was for many years active in the International Federation of National Standardizing Associations (ISA).

Head of the Swedish Delegation to the London Conference in 1946, at which the organizational structure of the ISO was established, Dr. Törnebohm was successful in securing agreement that all types of screw threads should be handled by a single committee, of which Sweden holds the Secretariat and to which Dr. Törnebohm has made significant contributions.

Under his guidance ISO Technical Committee 4—Ball and Roller Bearings—has been enabled to carry on the effective work commenced by the previous ISA committee.

Many of his technical books and articles have been translated into foreign languages. His improvements in the manufacture of machine tools, especially ball and roller bearings, and his promotion of gaging techniques have resulted in approximately 20 patents in 12 countries.

Dr. Törnebohm was born in Ljungby, Sweden, in 1891, and in 1913 received a CE degree in the Mechanical Division of the Royal Institute of Technology, Stockholm. He served as an instructor at the Institute for some years and was also employed as an engineer by Messrs. Frank Hirsch, Ltd., Stockholm, and the Swedish Gear Manufacturing Co., Gothenburg.

A Fellow of ASME, he belongs to several technical societies and has been honored by many governments and institutions of learning.

Clyde E. Williams

In naming Clyde E. Williams an Honorary Member of the ASME, the Society pays tribute to a man who has had a distinguished and varied career as a scientist, metallurgist, and engineer, and who is an outstanding organizer, administrator, and executive.

Dr. Williams was appointed assistant director of the Battelle Memorial Institute when it was founded in 1929. In 1934 he became director of this rapidly growing research foundation, and under his leadership Battelle has become one of the foremost institutions of its kind in the world. Technical papers based on research work done at Battelle are an essential part of the programs of American metallurgical, ceramic, and fuel organizations, and professional societies.

Clyde E. Williams

A native of Salt Lake City, Utah, Dr. Williams graduated from the University of Utah with a Bachelor of Science degree in chemical engineering in 1915. He holds honorary degrees from the University of Utah, Michigan College of Mining and Technology, Ohio State University, and Marietta College. He has had widely diversified experience in lead, zinc, and copper smelting, alloy steels, ferroalloys, and refractories, and has a keen appreciation of the technical problems of the metal industries.

During World War II Dr. Williams made many valuable contributions, the most vital of which was in his capacity as chief of the War Metallurgy Division of the Office of Scientific Research and Development and as chairman of the War Metallurgy Committee of the National Research Council, which had the job of establishing and supervising the scores of war-research projects in metallurgy at universities and research institutes all over the country. Many honors were conferred upon Battelle Memorial Institute and upon its director during the war.

These honors include the Army Ordnance Distinguished Service Award, the Naval Ordnance Development Award for "distinguished service and outstanding contributions to ordnance progress," and a Chemical Engineering Achievement Award for contributions to the development of the atomic bomb.

Besides his directorship of Battelle, Dr. Williams has many other business, academic, and governmental affiliations. Important among these is the Subcommittee on Research Activity in the Department of Defense, the Department of Defense Committee on Business Organization, and Commission on Organization of the Executive Branch of the Government (Hoover Commission).

Dr. Williams holds many patents and is the author of numerous publications. He is past-president, 1947, of the American Institute of Mining and Metallurgical Engineers.

The American Society of Mechanical Engineers is numbered among the many other technical and scientific societies, foreign as well as American, in which he holds membership.

Joint Engineering Societies Awards

The John Fritz Medal

THE John Fritz Medal is awarded annually for notable scientific or industrial achievement. One of the most important of the joint awards, and also one of the most notable engineering awards in this country, it is bestowed without restriction as to nationality or sex. Participating in the award of this honor are the Founder Societies: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

The friends and associates of John Fritz established this medal to perpetuate the memory and accomplishments of this great pioneer in the iron and steel industry. Mr. Fritz was president of AIME in 1894, and president of ASME in 1895. He was elected to honorary membership in ASME in 1900. He exercised probably the greatest early influence on steelmaking in America. One of his noteworthy accomplishments was the design and erection of facilities at the Bethlehem Steel Company, among the largest and most complete in the world.

The medal was first awarded on August 21, 1902, to John Fritz on the occasion of his eightieth birthday.

JOHN FRITZ MEDAL BOARD OF AWARD

John H. R. Arms, *Secretary*

ASCE—Gail A. Hathaway, Carlton S. Proctor, Walter L. Huber, Daniel V. Terrell.

ASME—J. Calvin Brown, R. J. S. Pigott, *Vice-Chairman*, Frederick S. Blackall, jr., Lewis K. Sillcox.

AIME—W. M. Peirce, Michael L. Haider, Andrew Fletcher, Leo F. Reinartz.

AIEE—T. G. LeClair, *Chairman*, F. O. McMillan, D. A. Quarles, Elgin B. Robertson.

Philip Sporn

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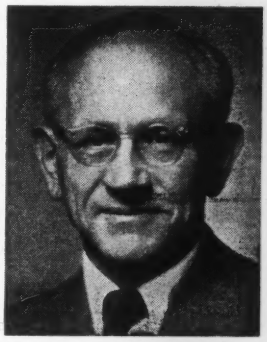


Philip Sporn

Mr. Sporn has devoted a great deal of time and effort to the study of nuclear energy, and particularly to the possibilities of its application in the field of power generation. Between 1949 and 1951 he served as chairman of the Ad Hoc Advisory Committee on cooperation between the electric-power industry and the Atomic Energy Commission, set up by the United States Atomic Energy Commission. He is a member of the Visiting Committee for the Nuclear Engineering and Reactor Departments of the Brookhaven National Laboratory. In 1952 he was elected president of the newly formed Ohio Valley Electric Corporation, a $440-million enterprise organized by 15 private electric-utility companies of the Ohio Valley region to supply the electric power of the Atomic Energy Commission's new $1.25-billion-dollar diffusion plant under construction in Pike County, Ohio. In 1955 he was elected president of Nuclear Power Group, Inc., a nonprofit organization dedicated to the investigation and development of nuclear-power technology. NPG will perform the research and development work for the 180,000-kw boiling-water reactor plant owned and operated by Commonwealth Edison Company and cosponsored by the eight companies which comprise NPG. Mr. Sporn served on the U. S. Delegation to the International Conference on Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, in August, 1955.

During World War II he was a consultant to the War Production Board and later was a member of the Electric Power Committee of the National Security Resources Board.

Mr. Sporn is the author of numerous papers presented before the leading engineering societies. He has contributed extensively to the technical press and is the author and coauthor, respectively, of "The Integrated Power System" and "Heat Pumps."

He is a Fellow of The American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Association for the Advancement of Science, and a member of the American Society of Civil Engineers, The Franklin Institute, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

The Daniel Guggenheim Medal

THE Daniel Guggenheim Medal for Aeronautics came into existence through a fund set aside in 1927 by the Daniel Guggenheim Fund for the Promotion of Aeronautics. It is awarded "not more often than annually, for notable achievement in the advancement of aeronautics," and with no restriction on account of race, color, nationality, or sex.

The administration of the Award is handled by a Board of Award composed of members of The American Society of Mechanical Engineers, Society of Automotive Engineers, and the Institute of the Aeronautical Sciences, also all former recipients of the medal living in the United States. The Board of Award is international in its membership, having representatives on it also from Canada, England, France, Germany, and Italy.

The first recipient of the medal was Orville Wright, who was designated to receive the Guggenheim Medal in 1929. The medal was actually conferred at a special convocation during ASME's Fiftieth Anniversary Celebration in Washington, D. C., April 8, 1930.

Subsequent recipients have been other world-famous engineers.

DANIEL GUGGENHEIM MEDAL BOARD OF AWARD

ASME—J. Carlton Ward, Jr., Robert B. Lea, Ralph S. Damon.

SAE—M. G. Beard, R. P. Kroon, E. C. Wells.

The John Fritz Medal. Established by the associates and friends of John Fritz, one of America's great pioneers in the iron and steel industry, to perpetuate his memory and his accomplishments in industrial progress.

The Hoover Medal. The services rendered by Herbert Hoover in the re-establishment of the injured nations during and after World War I served as the specific inspiration for this award for distinguished public service.

The Elmer A. Sperry Award seeks to encourage progress in engineering of transportation and commemorates Dr. Sperry's achievements. Established in 1955, it marks several important dates: ASME's 75th Anniversary, SAE's 50th Anniversary, and 95th Anniversary of Dr. Sperry's birth.

IAS—L. B. Richardson, S. Paul Johnston, C. J. McCarthy.

John H. R. Arms, *Member at Large*.

Life Members—Jerome Clarke Hunsaker, William Edward Boeing, William Frederick Durand, Donald W. Douglas, Glenn L. Martin, Juan Terry Trippe, James H. Doolittle, Lawrence D. Bell, Theodore P. Wright, Lester D. Gardner, Leroy R. Grumman, Edward P. Warner, Hugh L. Dryden, Igor Ivan Sikorsky, Charles A. Lindbergh.

International Members—John Hamilton Parkin, Sir Sydney Camm, Louis Breguet (Died May 4, 1955), Friedrich Seewald, Giuseppe Gabrielli.

Theodore von Karman

Theodore von Karman, world-famous aerodynamicist, has had a brilliant career as an educator, industrialist, and more recently as an adviser. He is at present chairman of the Advisory Group for Aeronautical Research and Development of the North Atlantic Treaty Organization, with headquarters in Paris, France.

After receiving an ME degree from the Royal Technical University of Budapest, and a doctorate from the University of Göttingen, Germany, he was appointed assistant professor at Göttingen in 1909. A year later he became professor of

The Gantt Medal. This award for achievement in the management field was established through the efforts of the early associates and friends of Henry Laurence Gantt, management and industrial engineer and leader in industry.

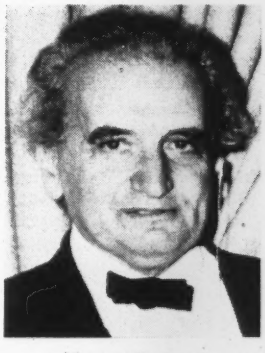
The Guggenheim Medal. This award was made possible by the gift of an endowment from the Daniel Guggenheim Fund for the Promotion of Aeronautics. Established in 1928, it honors notable achievement in aeronautics.

aeronautics and director of the Aeronautical Institute of the University of Aachen. In 1930 he went to California Institute of Technology as professor of aeronautics, director of its Guggenheim Aeronautical Laboratory, and chairman of the Graduate School of Aeronautics. He was instrumental in making the Aeronautics Division at the Institute one of the foremost in the world.

Dr. von Karman, with four other scientists, formed the Aerojet Engineering Corporation (now Aerojet-General Corporation) in 1941. The corporation rapidly grew to one of the most important rocket-manufacturing companies in the country.

During World War II he was appointed chairman of the Scientific Advisory Board of the U. S. Air Force. He also acted as consultant for both the Army and the Navy; and as a member of the National Advisory Committee for Aeronautics and of the Office of Scientific Research and Development. In recognition of his work during the war he was awarded the Presidential Medal for Merit, the highest civilian award in the United States.

He is best-known for his theories of the vortex motion and turbulence in fluids, and for his work in supersonic aerodynamics. He has made many contributions to the theory of elasticity, the knowledge of strengths of materials, hydrodynamics, thermodynamics, and aerodynamics. He is also an authority on wind-tunnel design.



T. von Karman

Dr. von Karman's many outstanding contributions to aeronautics have won him scores of decorations and orders, honorary degrees, and awards—not only from this country, but from Belgium, England, France, and Italy as well. When the John Fritz Medal was presented to him in 1948, the citation read, "Creative leader, stimulating teacher, and wise counselor." Dr. von Karman has also received the ASME Medal from The American Society of Mechanical Engineers, the Sylvanus Albert Reed Award of the Institute of the Aeronautical Sciences, The Franklin Medal of The Franklin Institute of Pennsylvania, and the Lord Kelvin Gold Medal from eight engineering societies of the United Kingdom. He has the distinction of being one of the fourteen non-French scientists elected to full membership in the French Academy of Sciences.

The Henry Laurence Gantt Gold Medal

To memorialize the distinguished achievements and great service to the community rendered by Henry Laurence Gantt, management engineer, industrial leader, and humanitarian, the Henry Laurence Gantt Gold Medal was established Nov. 19, 1929, to be awarded for "distinguished achievement in industrial management as a service to the community." The award is administered by a board comprised of representatives of The American Society of Mechanical Engineers and the American Management Association.

The Medal was designed by Julio Kilyeni, a sculptor who had achieved distinction as the designer of fine medals, including the Fiftieth Anniversary Medal of The American Society of Mechanical Engineers. The Certificate of Award was designed by Meiric K. Dutton, a well-known designer of fine printing. The Medal bears on the rim the name of the medalist and the date of the award. The basis for the award is stipulated in the certificate.

The first Medal was awarded posthumously, in 1929, to Mr. Gantt himself. The current medalist is the twenty-fourth recipient.

GANTT MEDAL BOARD OF AWARD

ASME—William R. Mullee, E. M. Derby, *Vice-Chairmen*, A. M. Perrin, F. W. Hornbruch, Jr.

AMA—L. C. Morrow, *Chairman*, J. Keith Louden, Ralph F. Gow, Harrison F. Dunning.

C. E. Davies, *Secretary*.

Walker L. Cisler

Walker Lee Cisler, president and director of The Detroit Edison Company, embarked on his long and successful career in power when he joined the Public Service Electric & Gas Company of New Jersey soon after being graduated in 1922 from Cornell University as a mechanical engineer. He rose to the position of assistant general manager of the electric department.

In 1943 he joined Detroit Edison as chief engineer of power plants. He was elected executive vice-president in 1948, and became president in 1951.

W. L. Cisler

As head of the company, Mr. Cisler has carried out a farsighted program of expansion and has been instrumental in the development of atomic energy for industrial and civilian purposes. Executive secretary of the AEC Industrial Advisory Group, he has been responsible for his company's participation in the Nuclear Power Development Project in co-operation with the Dow Chemical Company. He is president of the Atomic Industrial Forum.

As chairman of the Edison Electric Institute Power Survey Committee since 1947, he inaugurated semi-annual studies of power supply and demand which have gained international recognition.

Mr. Cisler gave distinguished service in World War II. After serving on the War Production Board and in the Office of War Utilities, in 1943 he was assigned the task of rehabilitating electric, gas, and water facilities in the Mediterranean area. In 1944 he was appointed a colonel and chief of the Public Utilities Section of Supreme Headquarters, Allied Expeditionary Forces in Europe. For his valuable work in the rehabilitation and operation of electric-power facilities he has been decorated by several foreign governments, as well as by his own government.

Despite a crowded business schedule, Mr. Cisler is an active participant in civic and governmental affairs. He has been a consultant to the War and State Departments on matters pertaining to electric power in occupied and other areas since 1945, and a consultant to the Mexican Government on electric-power problems since 1946. He is president of the Fund for Peaceful Atomic Development; president of "Greater Michigan, Inc."; chairman of the Austrian Flood Relief Disaster Campaign; and chairman of the Detroit Committee for Netherlands Flood Relief. In 1954 he revisited 12 European countries for the United States Government to review their progress in electric-power rehabilitation.

He is a Fellow of The American Society of Mechanical Engineers and serves on many of the Society's technical and administrative committees. Currently he is chairman of the ASME Nuclear Energy Application Committee and the Board of Public Affairs. He is also a Fellow of the American Institute of Electrical Engineers, a member of Tau Beta Pi, and a trustee of Cornell University.

The Hoover Medal

The Hoover Medal, instituted in 1930, is awarded for great, unselfish, nontechnical services by engineers to their fellow men. It was established to commemorate those principles and ideals of civic obligation and of public service exemplified by Herbert Hoover's life and work. The Medal bears the inscription "Awarded by engineers to a fellow engineer for distinguished public service."

The trust fund creating this award was established through a gift of Conrad N. Lauer, a past-president of The American Society of Mechanical Engineers. The fund has been augmented by other donations in recent years, the latest an anonymous contribution earlier this year.

It is administered by the Hoover Medal Board of Award, consisting of representatives from the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

The first award was made to Mr. Hoover at the Fiftieth Anniversary Dinner of The American Society of Mechanical Engineers, held in Washington, D. C., April 8, 1930. Since then the medal has been awarded to engineering leaders in industry, administration, research, and education, who have performed outstanding service to their community, nation, or fellow men.

HOOVER MEDAL BOARD OF AWARD

ASCE—Ezra B. Whitman, Malcolm Pirnie, Carlton S. Proctor.

AIME—Scott Turner, *Chairman*, Cadwallader Evans, Jr., John R. Suman.

ASME—A. L. Penniman, Jr., *Vice-Chairman*, Clair B. Peck, Morehead Patterson.

AIEE—David C. Prince, Titus G. LeClair, D. D. Ewing.

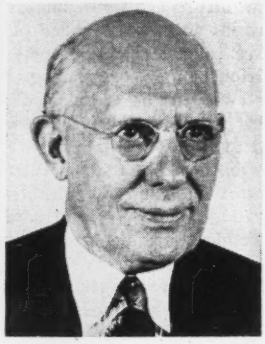
C. E. Davies, *Secretary to the Board*.

Charles F. Kettering

It is most fitting that the recipient of the Hoover Medal should be Charles F. Kettering, eminent scientist, engineer, inventor, philosopher, organizer of scientific research, developer of engineering devices and techniques, and leader in industrial research, whose ideals and accomplishments have been inspirations to men of many nations.

Dr. Kettering, who was born in Ashland County, Ohio, graduated from Ohio State University in 1904. He received his doctorate in engineering from the same institution in 1929. He holds honorary degrees from 29 institutions.

After serving for 27 years as a vice-president of General Motors Corporation and general manager of their Research Laboratories Division, Dr. Kettering is now retired and serves as research consultant and a director of the company.



C. F. Kettering

He was the founder, in 1927, of the Charles F. Kettering Foundation. He serves as chairman of the board of the Foundation, directing researches in the natural sciences, including work on chlorophyll and photosynthesis, artificial fever therapy, and cancer. He is director of the world-renowned Sloan-Kettering Institute for Cancer Research, and president of the Thomas Alva Edison Foundation. He is a trustee of the Southern Research Institute, Ohio State University, Antioch College, and College of Wooster, Ohio.

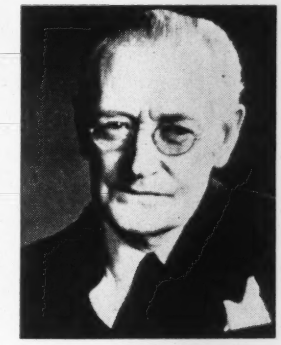
Dr. Kettering's scientific work includes the invention of automotive starting, lighting, and ignition systems, electrified cash register, credit systems, and accounting machines. He originated and guided researches resulting in higher-octane gasolines, extraction of bromine from sea water, high-compression automobile engines, improved automobile finishes, nontoxic and noninflammable refrigerants, and improved diesel engines. He has been responsible for, or contributed to, many other developments of industrial importance.

He has served as chairman of the National Inventors Council, National Patent Planning Committee, and the Engineering and Industrial Research Division of the National Research Council. He is a member of the Scientific Advisory Board of the National Research Council, a Fellow of the National Academy of Sciences, past-president of the American Association for the Advancement of Science (1945), and past-president of the Society of Automotive Engineers (1918).

Dr. Kettering is a Fellow of The American Society of Mechanical Engineers and of the American Institute of Electrical Engineers, and a member of the American Society of Civil Engineers. He also holds membership in other engineering and scientific societies.

The Elmer A. Sperry Award

This Award seeks to encourage progress in the engineering of transportation. It commemorates the life and achievements of Dr. Elmer A. Sperry, whose versatile inventiveness encompassed virtually all science and industry, accelerated the progress of transportation by land, sea, and air, created basic industrial machinery and processes, and pioneered the organization and direction of group research.



W. F. Gibbs

Established by his daughter, Helen, now Mrs. Robert Brooke Lea, and his son, Elmer A., Jr., this new Award is to be available for presentation annually to that individual or group, of any nationality, adjudged, after nomination and thorough consideration, to have made "a distinguished engineering contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea, or air."

Recipients of the Award will be selected by a Board of Award representing four technical societies of which Dr. Sperry was officer or member: The American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society of Automotive Engineers, and The Society of Naval Architects and Marine Engineers.

Appropriately, this Award has been established and a special biographical memoir of Dr. Sperry published in 1955, year of the 75th Anniversary of ASME, 50th Anniversary of SAE, 95th Anniversary of Dr. Sperry's birth, and 25th Anniversary of his death.

ELMER A. SPERRY BOARD OF AWARD

ASME—Robert B. Lea, *Chairman*, William L. Batt.

AIEE—Edward H. Anson, W. N. Zippler.

SAE—Jerome C. Hunsaker, William Littlewood.

SNAME—Herbert L. Seward, C. Richard Waller.

C. E. Davies, *Secretary*.

William Francis Gibbs

As naval architect and marine engineer, Mr. Gibbs has dedicated more than 30 years to advocacy of superships and the application of modern designs and materials to shipbuilding. He began experimenting with superships in 1913 and had advanced the concept to the point of construction, when World War I and the ensuing depression interrupted.

During that war he served with the Shipping Control Committee of the Army General Staff. In 1919 he became construction chief for International Merchant Marine. In 1922, at government request, he organized Gibbs Brothers, Inc., to supervise the reconditioning of the SS *Leviathan* and other ships. In 1929 the firm became Gibbs & Cox, Inc., which has designed a large proportion of modern American merchant, naval, and other ships.

Upon the outbreak of World War II, Mr. Gibbs designed emergency cargo ships for the British Government, Liberty ships for the American Government, and a wide variety of naval combatant and service craft for the U. S. Navy. He served as wartime Controller of Shipbuilding, War Production Board, and as Chairman, Combined Shipbuilding Committee, of the Chiefs of Staff.

In 1946 Mr. Gibbs undertook, for the United States Lines, the design of the SS *United States* as a 30-knot transatlantic superliner incorporating his concepts, techniques, and uses of materials. Built to rigid naval requirements for possible use as transport, this ship has brought the transatlantic speed ribbon back to America and has achieved world-wide recognition for advanced engineering in transportation.

Mr. Gibbs was born August 24, 1886. He was graduated from Harvard in 1910. He entered Columbia in 1911 and was graduated in 1913 with the Bachelor of Laws and Master of Arts degrees.

Among his honors are the National Defense Transportation and American Design Awards, The Franklin Gold Medal, and for notable achievement both in naval architecture and marine engineering, the David W. Taylor Gold Medal.

Mr. Gibbs holds the honorary degree Doctor of Engineering from Stevens Institute of Technology and New York University, and Doctor of Science from Harvard and Bowdoin.

ASME Honors and Awards

The ASME Medal

The ASME Medal, established in 1920, is awarded for *distinguished service in engineering and science*. The Society established this award so that it might give recognition not only to outstanding engineering achievement, but also to achievement in science which is capable of application in engineering fields. Through the years the world's engineers and scientists have come to regard the ASME Medal as a reward of merit which ranks among the highest in the scientific field.

Perhaps this is because of the broad interpretation of engineering and science which has been used by the Society in bestowing this medal. To qualify for the ASME Medal a person does not have to be a member of ASME or even an engineer. He may be a scientist, industrialist, public official, or anyone who has rendered distinguished service in engineering and science. The award has been made in areas of:

1 Scientific, experimental, and industrial research and development, and the organization and administration of such activities.

2 The application of the results of research to the design and/or operation of equipment, plants, organizations, methods, and processes.

3 Technical and industrial leadership in the organization and administration of research, engineering, and industrial operations.

The roll of ASME Medallists contains the names of eminent engineers and scientists who have rendered distinguished service in their chosen fields of endeavor, such as management, manufacturing, physics, power generation, engineering design, machine tools, lubrication, air conditioning, optics, and marine construction.

The first ASME Medal was awarded to Hjalmar G. Carlson in recognition of the services he rendered the government through his invention and production of drawn-steel booster casings.

Granville M. Read

Mr. Read was born in New London, Va., in 1894, and was educated at Virginia Polytechnic Institute and the Sorbonne, Paris, France. He began his career with du Pont in 1915 as a centrifuge operator at the Hopewell, Va., guncotton plant which the company was operating for the government.

G. M. Read

At Hopewell he soon became engaged in technical assistance work and continued in this line with du Pont in Wilmington after World War I. He was in charge of industrial engineering at Chambers Works prior to his appointment in 1930 as assistant manager of du Pont's industrial engineering division.

Named manager of the War Construction Division of du Pont in 1941, Mr. Read supervised the erection of 54 wartime ordnance facilities built for the government at 32 locations. He was made assistant chief engineer in 1943, in which capacity he was in charge of the design and construction of major war plants, including the Hanford Engineer Works for the production of plutonium.

Mr. Read has been chief engineer of the du Pont Company since 1946. He is currently responsible for the engineering and construction of the $1.3 billion Savannah River Project near Aiken, S. C., which is nearing completion under contract with the Atomic Energy Commission.

In 1951 Mr. Read received an honorary DS degree from the University of Delaware. He was named a trustee of that university in 1954, and in the same year was also appointed to the board of visitors of Virginia Polytechnic Institute. A director of the Remington Arms Company, Inc., he is a member of Tau Beta Pi, honorary engineering fraternity, and Omicron Delta Kappa, national leadership fraternity. Mr. Read is a member of the American Institute of Chemical Engineers and The American Society of Mechanical Engineers.

ASME Westinghouse Medal

The ASME George Westinghouse Gold Medal, which was first presented at the Society's 1953 Annual Meeting, is bestowed annually, if warranted, for "eminent achievement or distinguished service in the power field of mechanical engineering."

It was instituted at the 1952 Annual Meeting at the suggestion of the Westinghouse Educational Foundation that such an award be established "to perpetuate the value of the rich contributions to power development made by George Westinghouse, Honorary Member and 29th President of the Society." At an early stage in the development of electric power, Westinghouse realized the potential value of utilizing alternating instead of direct current and was instrumental in developing the necessary apparatus, including the transformer, the induction motor, and the steam turbine.

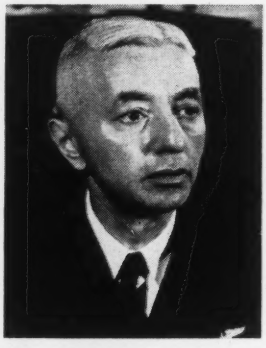
Based upon a broad interpretation of the term "power," the award recognizes contributions of utilization, application, design development, research, and the organization and administration of such activities in the power field. Candidates are not restricted by age or profession, nor is membership in any engineering society or organization a factor.

The first two recipients were Alexander G. Christie, emeritus professor of mechanical engineering at The Johns Hopkins University, and Walker L. Cisler, president of The Detroit Edison Company.

The Westinghouse Educational Foundation, which furnished a gift for endowment of the award in 1953, engages in a wide program for the promotion of science and education.

Hyman G. Rickover

Rear Admiral Hyman George Rickover enjoys the unique distinction of having implemented the Navy's nuclear-ship program "beyond all expectations," thus accomplishing "the most important piece of development in the history of the Navy." So reads a



H. G. Rickover

The ASME Medal. Established in 1920, it was one of the earliest awards of the Society. It is awarded annually for distinguished service in engineering and science.

ACHIEVEMENT OR DISTINGUISHED SERVICE IN THE POWER FIELD OF MECHANICAL ENGINEERING FOREVER MEMORIAL
COMMEMORATING THE LIFE AND WORK OF
GEORGE W. SINGHOUSE
ALEXANDER G. CHRISTIE
1953

George Westinghouse Gold Medal. This newest ASME medal was instituted to perpetuate the value of the rich contributions to power development made by George W. Westinghouse, Honorary Member and Past-President of ASME.

Navy commendation received by him in 1952.

Admiral Rickover's first assignment in atomic-energy work took him in 1946 to the AEC's Manhattan Project at Oak Ridge, Tenn. Subsequently he and other officers who had been at Oak Ridge worked on the atomic-powered submarine project for the Navy Bureau of Ships.

In 1947 he first proposed construction of a nuclear-powered submarine. As a result of his enthusiasm and persistence, an appropriation for this purpose was made in 1949. By this time he held the Navy post of director, Nuclear Power Division, Bureau of Ships, in addition to being chief of the Naval Reactors Branch, Division of Reactor Development. In 1953 he was promoted to rear admiral.

Admiral Rickover was born in 1900 and was appointed to the U. S. Naval Academy from the State of Illinois in 1918. He was commissioned an ensign in 1921 and for the next five years served aboard the USS *La Vallette* and the USS *Nevada*. He returned to the Naval Postgraduate School at Annapolis for instruction in electrical engineering and continued his study at Columbia University, receiving an MS degree in electrical engineering in 1929.

After tours that included submarine duty he was selected for engineering duty and, in June, 1939, he was assigned to the Bureau of Ships, Navy Department, Washington.

For his outstanding services as head of the Electrical Section he received the Legion of Merit. In 1945 he served as commanding officer of the Naval Repair Base at Okinawa, for which he received a letter of Commendation with authorization to wear the Commendation Ribbon.

Admiral Rickover has many other service decorations and in 1948 received the Order of the British Empire with rank of Honorary Commander for his achievements in electrical research during World War II.

The Holley Medal

Early in 1920 George I. Rockwood, Honorary Member of the Society, and its Vice-President in 1924 and 1925, proposed that the Society establish an award in the form of a gold medal to be given to an engineer for distinguished service in engineering and science. The Council accepted his suggestion and voted to have the first award made in December 7, 1921, to Hjalmar G. Carlson, even though the medal was not endowed or ready at that time.

For the time being the award was called the Great Achievement Gold Medal. Later, at the request of Mr. Rockwood, this gold medal was named the Holley Medal in honor of Alexander Lyman Holley, one of the founders of ASME and the man responsible for bringing the Bessemer process of steelmaking to this country. The medal was endowed by Mr. Rockwood in 1924, and the first medal was struck and awarded to Mr. Carlson the same year.

The general rules laid down in the deed of gift specify:

"The Holley Medal shall be bestowed only on one who by some great and unique act of genius of an engineering nature has accomplished a great and timely public benefit.

"...No limitation shall arise out of... membership or lack of membership in any society or organization...Attention shall be

The Holley Medal. This award was instituted and endowed by George I. Rockwood, Honorary Member of the Society. It was first called the Great Achievement Gold Medal.

Worcester Reed Warner Medal. An award for excellence in papers established by a provision in the will of Worcester Reed Warner, Honorary Member and President of ASME in 1897.

concentrated on the brilliance and benefit of his act—not on the man.

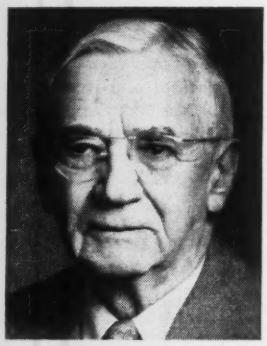
"The achievement should be of such public importance as to be worthy of the gratitude of the nation, and call forth the admiration of engineers. It should therefore be reserved for those meriting the highest honor within the gift of the mechanical engineering profession."

Prestige of the Holley Medal is high among engineers because, in compliance with the foregoing strict provisions, it is not awarded annually but only when thoroughly warranted. The medal has been awarded for such acts of genius as the invention or development of gyroscopic principles and applications, the cyclotron, the Norden bombsight, and jet propulsion.

George J. Hood

The Holley Medal is awarded to George J. Hood, professor emeritus of the University of Kansas School of Engineering, for his outstanding humanitarian service in the invention and development of the dermatome, a skin-grafting instrument for surgical treatment of severe burns. The device, which will cut accurate skin grafts as large as 15 × 8 in. and of uniform predetermined thickness from 5 to 50 thousandths of an in., has already saved thousands of lives throughout the world.

A native of Chicago, Ill., where he was born in 1877, Professor Hood taught engineering drawing at the University of Kansas from the time of his graduation there with a BS degree in 1902 until his retirement in 1947. In 1917 he received a degree in mechanical engineering and was appointed full professor. He is the author of "Descriptive Geometry by the Direct Method" (three editions) and of the well-known textbook, "Geometry of Engineering Drawing."



G. J. Hood

Other valuable inventions by Professor Hood include gas engines, a gas explosive pump, drawing instruments, an autographic device for the film pack, and a photographic method for producing perspective layouts from aircraft sections.

He is a member of Sigma Xi, Tau Beta Pi, and Alpha Tau Omega. The American Society for Engineering Education, of which he is also a member, honored him in 1952 with their Distinguished Service Award.

Worcester Reed Warner Medal

Established in 1930 at the bequest of Worcester Reed Warner, charter member and sixteenth President of the Society, the medal is awarded for an outstanding contribution to the permanent literature of engineering. Permanent literature is defined, for the purposes of this award, as either a book or books, or a single paper or group of papers, which has been recognized as a noteworthy contribution which shall not be less than five years old. Among the medalists listed are Dexter S. Kimball, Charles M. Allen, C. F. Hirshfeld, and Max Jakob.

Contributions are to deal with pro-

gressive ideas in mechanical engineering or efficiency in management as specified in the "deed of gift." This has been interpreted as applicable to any paper or treatise which contains progressive ideas relative to engineering, scientific, and industrial research associated with mechanical engineering; the design and operation of mechanical and associated equipment; industrial engineering or management, organization, operations, and the concomitants of each; and other subjects closely associated with any of the afore-mentioned.

Any paper or treatise to qualify as having permanent value shall be not less than five years old.

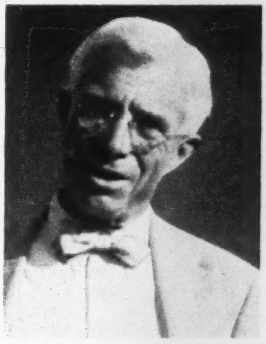
Recipients may be nonmembers of the Society. Contributions for this award should not be confused with those submitted for the Melville Medal which is awarded for an original paper or treatise which is current and timely, but which may or may not have permanent value.

Howard Stewart Bean

The name of Howard Stewart Bean is as synonymous with flow measurement as is McAdams with heat transfer and Den Hartog with vibration. Chief of the Capacity, Density, and Fluid Meters Section of the National Bureau of Standards since 1948, Mr. Bean has also served in a consulting or supervisory capacity for most of the fluid-meter research programs in this country. His contributions to ASME committee projects have been invaluable; he has written numerous papers relating to his specialty.

After a year as inspector of weights and measures in the Gage Section, NBS, Mr. Bean became chief of the New York Branch, Gage Section, NBS, in 1918. From 1920 to 1948 he was chief of the Bureau's Gas Measuring Instruments Section.

As chairman of the ASME Fluid Meters Subcommittee on Revision of Part I, Fluid Meters, Their Theory and Application, since 1942 (member since 1930), he has assembled the data and written much of the text for this authoritative manual, both in the original and its several revisions. From 1936 to 1946 he was chairman of the ASME committee on flow-nozzle research, and for 20 years he has been active in the ASME Power Test Code Committee No. 19 on Instruments and Apparatus. Joint AGA-ASME committees on flow measurement have benefited for many years from his direction of research projects on orifice meters. Mr. Bean is chairman of ASTM Committee D-3-II on Measurement of Gaseous



H. S. Bean

Samples and has contributed essentially to the important work of the ASME-API Committee on Volunteer Research in developing Code 1101 for measurement of petroleum products handled in transportation.

Elected a Fellow of ASME in 1949, Mr. Bean belongs to AGA, Sigma Xi, the Washington Academy of Sciences, and is active in civic affairs. A native of California (Santa Clara County, 1893), he received a BS in mechanical engineering from the University of California, Berkeley, in 1917.

Spirit of St. Louis Medal

When Charles A. Lindbergh in his airplane, *The Spirit of St. Louis*, completed his lone transatlantic flight there was an immediate and tremendous increase of interest in aeronautics on the part of the public, which in turn provided a great impetus to the aeronautical industry. As a result, his plane, *The Spirit of St. Louis*, became a symbol for noteworthy achievement in American aeronautics.

The Spirit of St. Louis Medal, to be awarded every three years for meritorious service in the advancement of aeronautics, was established in 1929 by the St. Louis Section of ASME through the generosity of Philip De Catesby Ball, ASME members, and other public-spirited St. Louis citizens.

On the obverse side of the medal, Victor S. Holm, the sculptor, depicts Icarus typifying the Spirit of Flight. According to Greek mythology, Icarus, with wings of eagle feathers made by Daedelus, flew so high that the wax holding the feathers was melted by the heat of the sun, causing the young man to fall into the sea and drown. Icarus symbolizes the flight aspirations and possibilities of the genius of man. Under the name of Icarus, which is in Greek, is found the year of the flight of Lindbergh in the *Spirit of St. Louis* to Paris—1927—a subtle and delicate compliment to man. The reverse side of the medal depicts the rearranged emblem of the Society, the traditional globe, lever, and hand based on the statement attributed to Archimedes: "Give me where to stand and I will move the earth." It is representative of the power man can exert through mechanical aids, of which the lever is one of the fundamental representations.

The first Spirit of St. Louis Medal was conferred on the late Daniel Guggenheim for his tremendously beneficial and unselfish contributions in the interest of aeronautics.

Ralph S. Damon

Ralph S. Damon, president of Trans World Airlines, is the 1955 recipient of ASME's Spirit of St. Louis Medal.

He has seen the aviation industry grow since he learned to fly as an Army cadet in World War I, as a worker and executive of aircraft-manufacturing plants, and as president of two major air lines.

Born in Franklin, N. H., in 1897, he attended Harvard University where he was graduated cum laude in 1918. He came out of the service in the first World War with a profound belief in the future of aviation.

Joining Curtiss Aeroplane and Motor Company in 1922, he became factory superintendent at the age of 25. Until 1935 he served in various capacities and at various plants of the Curtiss-Wright organization and affiliated companies, becoming president in 1932. During this period he was instrumental in developing such noted aircraft as the Curtiss Robin and Thrush, Curtiss-Wright Junior, and the Condor, first all-sleeper transport airplane.

In 1936 Mr. Damon entered the air-transport field as vice-president of operations of American Airlines. During World War II, at the request of the government, he returned to production as

R. S. Damon

Spirit of St. Louis Medal. Named for Charles A. Lindbergh's famous plane, this award was established by an endowment fund created in 1929 by the citizens of St. Louis, Mo.

president of Republic Aviation Corporation, Farmingdale, L. I. In this capacity he put into high gear the mass production of the famous P-47 Thunderbolt fighter.

On completion of this assigment in 1943, he returned to American Airlines, where he was elected president in 1945. Following his resignation as president of American Airlines in January, 1949, he moved into the field of international as well as domestic air transport, becoming president of TWA.

Mr. Damon is a member of The American Society of Mechanical Engineers, the Institute of the Aeronautical Sciences, and the Society of Automotive Engineers. He is a member, by Presidential appointment, of the National Advisory Committee for Aeronautics (NACA), and is a member of the Aviation Advisory Committee of the Harvard School of Business Administration. Mr. Damon is also active as chairman of the Board of Trustees of Clarkson College of Technology at Potsdam, N. Y. For his keen interest in assistance to Greece he has been made an honorary citizen of Athens.

Spirit of St. Louis Junior Award

John B. Nichols

The Spirit of St. Louis Junior Award, established by the Society in 1938, is awarded in conjunction with the Spirit of St. Louis Medal. It is presented to the associate member, under 30 years of age, presenting the best paper on an aeronautical-engineering subject during the three-year period.

This year's award goes to John Burton Nichols for his paper "An Energy Basis for Comparison of Performance of Combustion," presented before ASME's Semi-

J. B. Nichols

Annual Meeting in June, 1952. Mr. Nichols is chief research engineer at Hiller Helicopters, Palo Alto, Calif.

Born in Brooklyn, N. Y., on Nov. 4, 1924, Mr. Nichols received a bachelor's degree in aeronautical engineering from Rensselaer Polytechnic Institute in 1945.

In July, 1945, he entered the United States Navy as an engineering officer. He was assigned to the assembly and repair department of the U. S. N. Air Station, San Diego, Calif., where he supervised the repair, overhaul, and revision of aircraft. The output was approximately ten transports and 30 fighters a month. In March, 1946, he became Engineering Officer of USS *ATA* 124, in charge of operation of all propulsion machinery, mechanical equipment, and towing apparatus.

Upon demobilization from the Navy in 1946, Mr. Nichols joined General Electric Company as a development engineer in the general engineering and consulting laboratory in Schenectady, N. Y. Here he did aerodynamic and thermodynamic work in conjunction with the XH-17 helicopter power plant. Later he was project engineer on the development of the pneumatic-turbine auxiliary power system for the B-52, and finally became head of the aircraft auxiliary turbine development section of the Thermal Power System Division. He left General Electric to join Hiller Helicopters in 1952.

Mr. Nichols has been an associate member of ASME since 1948. He is a member of the Institute of the Aeronautical Sciences and the American Helicopter Association of Great Britain. He is also a member of Tau Beta Pi and Sigma Xi.

Melville Medal

One of the earliest awards established by ASME, the Melville Prize Medal for original work was created in 1914 by the bequest of Rear Admiral George W. Melville, past-president and Honorary Member of the Society, to encourage excellence in papers. It is awarded annually to an ASME member for an original paper or thesis of exceptional merit presented before the Society for discussion and publication during the preceding year.

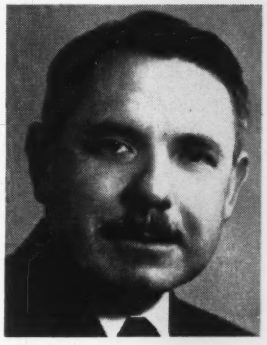
The Melville Medal, more than any other medal of the Society, is symbolic of the many adventures which await the mechanical engineer in the practice of his profession, a phase of engineering so well illustrated by the eventful life of Admiral Melville. He saw a great deal of action as an engineer officer in the U. S. Navy during the Civil War, and was the engineer on the famous ill-fated expedition of the *Jeannette* to the Arctic. Appointed Chief of the Bureau of Engineering and Engineer in Chief of the Navy in 1887, he made many significant changes and improvements. As early as 1903 he advocated the installation of turbines in a Navy vessel for experimental purposes.

Admiral Melville was an Honorary Member of ASME and its President in

Melville Medal for Original Work. Rear Admiral George W. Melville was responsible for the establishment of this medal which was first awarded in 1927. It is an annual award.

1899. In his will he made provision for the establishment of a Melville gold medal for original work, to be awarded annually "to such competing member of the ASME as shall present the best original paper or thesis on any mechanical-engineering subject presented to the Society for discussion and publication." Only papers of single authorship are eligible for this medal. It is usually presented during the Annual Meeting of the Society.

Since the first Melville Medal was awarded to Leon P. Alford in 1927, there has been a line of distinguished recipients.



R. T. Knapp

Robert T. Knapp

Prof. Robert T. Knapp's paper, "Recent Investigations of the Mechanics of Cavitation and Cavitation Damage" (presented at the ASME Annual Meeting in November, 1954), has won him the Melville Medal for 1955. Dr. Knapp, director of the Hydrodynamics Laboratories and professor of Hydraulic Engineering at California Institute of Technology, has rendered distinguished service to the engineering profession, as well as to his state and country.

Professor Knapp was born in Loveland, Colo., in 1899. He received a BS (ME) degree from the Massachusetts Institute of Technology in 1920, and a PhD(ME) from California Institute of Technology in 1929. He became an instructor at the California institution in 1922, ultimately attaining a full professorship (hydraulic engineering) in 1950.

Besides his teaching duties, Professor Knapp has served on various state and federal projects. From 1932 to 1936 he was in charge of a special investigation of beach, harbor, and channel problems for the Los Angeles Gas and Electric Corporation and the Los Angeles County Flood Control District, which included the design and construction of a model basin, experimental channel, and variable inclination flume for study of open channel flow at high velocities. From 1933 to 1937 he served as a consultant on the Metropolitan Water District's co-operative Hydraulic Machinery Laboratory at California Institute of Technology, which was initiated for the purpose of studying the problems involved in the pumping plants of the Colorado River Aqueduct, which were of unprecedented capacity and lift. He has also served as hydraulic consultant to the U. S. Department of Agriculture, Soil and Conservation Service, and the U. S. Bureau of Reclamation. In the latter he studied the pumping problems related to the development of the Grand Coulee Irrigation Project.

Professor Knapp has worked on numerous wartime and postwar projects for the Army, Navy, and the Bureau of Ordnance. These include an emergency study for the U. S. Navy to aid in maintaining an antisubmarine net in the Golden Gate, and investigations on hydrodynamic and ballistic problems involved in air and water trajectories of rockets, bombs, torpedoes, etc. He has also been director of model studies for the Bureau of Yards and Docks of the U. S. Navy, investigating hydrodynamics and wave and surge problems at naval bases.

He is active in community, national, and political affairs. He is a Life Member of the ASME. Other memberships include the American Society of Civil Engineers, the American Geophysical Union, and the honorary scientific and engineering fraternities Sigma Xi and Tau Beta Pi.

Pi Tau Sigma Gold Medal

The Pi Tau Sigma Gold Medal Award was established in 1938 through an endowment by Pi Tau Sigma, national honorary mechanical-engineering fraternity. It is awarded annually to a young mechanical engineer for outstanding achievement in mechanical engineering within ten years after graduation from a regular four-year mechanical-engineering course in a recognized American college or university. Any mechanical-engineering graduate not more than 35 years of age, except for candidates graduating not later than the year 1950, is eligible. His achievement can be in any field, including industrial, educational, political, research, civic, or artistic.

Nominations may be made by any member or group of members of Pi Tau Sigma, any Section of ASME, the head of the mechanical-engineering department of any American college or university offering the regular four-year course or its equivalent in mechanical engineering, and other qualified individuals. From the nominations submitted Pi Tau Sigma recommends to the ASME Board on Honors ten candidates for this award. The Board then selects the recipient and, with Council approval,

Pi Tau Sigma Award

the awards are usually presented at the ASME Annual Meeting.

Robert C. Dean, Jr.

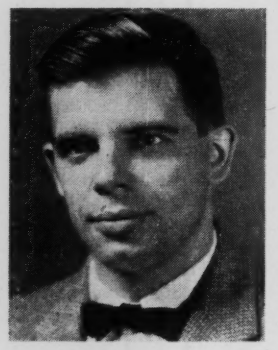
The recipient of this year's Pi Tau Sigma Gold Medal is Robert C. Dean, Jr., assistant professor at the Massachusetts Institute of Technology, whose specialty is fluid machinery. He teaches mechanical-engineering subjects and conducts research in the Gas Turbine Laboratory.

Professor Dean was born in Atlanta, Ga., in 1928. He received the BS and MS degrees in mechanical engineering in 1949 from M.I.T., and a DS in mechanical engineering from the same institution in 1954.

While a student, Professor Dean held responsible positions in industry during the summer-vacation periods. He spent from June to September, 1948, at General Electric Company, River Works, Lynn, Mass., as a test engineer, in the design and development of aircraft gas-turbine test equipment. From June, 1949, to September, 1951, he was employed at the Ultrasonic Corporation, Cambridge, Mass., first as a field engineer, and later as a project engineer. In this position he was concerned with the design and application of sonic energy to industrial processes, manufacturing sonic and gas-cleaning equipment.

Professor Dean is an Associate Member of ASME, and is the Faculty Adviser of the ASME Student Branch at M.I.T. He is also a member of the Institute of the Aeronautical Sciences, and of the honorary engineering fraternities Pi Tau Sigma and Tau Beta Pi.

In addition to his Society activities on the Compressor and Turbine Committee of the ASME Gas Turbine Power Division and on the Program Committee of the ASME Boston Section, Professor Dean is also a member of the N.A.C.A. Subcommittee on Compressors and Turbines, and has been active in civic affairs in his home town of Natick, Mass.



R. C. Dean, Jr.

Richards Memorial Award

The Richards Memorial Award, established in 1944, was named in honor of Charles Russ Richards, founder of Pi Tau Sigma, honorary mechanical-engineering fraternity.

It is given annually to the mechanical engineer who has demonstrated outstanding achievement within 20 to 25 years following graduation from a regular mechanical-engineering curriculum in a recognized college or university. His achievement may be all or in part in any field, including industrial, educational, political, research, civic, or artistic.

Nominations may be made by any member or group of members of Pi Tau Sigma, any Section of ASME, the head of the mechanical-engineering department of any American college or university offering the regular four-year course or its equivalent in mechanical engineering, and other qualified individuals. From the nominations submitted Pi Tau Sigma recommends to the ASME Board on Honors ten candidates for this award. The Board then selects the recipient and, with Council approval, the awards are usually presented at the ASME Annual Meeting.

Sylvan J. Cromer

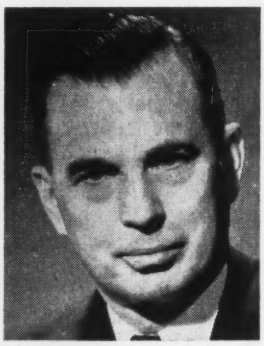
The 1955 Richards Memorial Award for outstanding achievement in mechanical engineering is conferred on Sylvan J. Cromer. A native of Marshall, Okla., Mr. Cromer received the BS degree in mechanical engineering in 1930, and the MS degree in 1937, from the University of Oklahoma. He joined the faculty of his alma mater in 1930 as assistant professor of mechanical engineering, later gaining additional experience teaching at Louisiana State University, and as research supervisor for the Division of War Research at Columbia University.

Associated with Carbide and Carbon Chemicals Company at Oak Ridge, Tenn., since 1944, Mr. Cromer is now director of the Aircraft Reactor Engineering Division and codirector of the Aircraft Nuclear Propulsion Project at the Oak Ridge National Laboratory (now under the operation of the newly formed Union Carbide Nuclear Company).

Before taking over his present position, Mr. Cromer served as assistant superintendent, and as superintendent, of the Engineering Development Division at the Gaseous Diffusion Plant in Oak Ridge, where he was in charge of process improvement work. He later became chief engineer, in charge of process design, on the new multimillion-dollar gaseous diffusion plants at Paducah, Ky., and Portsmouth, Ohio, and the recent expansion of the Oak Ridge plant. Just prior to his transfer to the Laboratory, Mr. Cromer was appointed superintendent of the Technical Division at the Gaseous Diffusion Plant, where he was responsible for engineering, development, and applied research, as well as operation of the Works Laboratory.

In the dual capacity in which he now serves at the Laboratory, one of the largest research installations in the world, Mr. Cromer is charged with the responsibility of co-ordinating the efforts of the various divisions concerned with problems in the nuclear propulsion of aircraft, and the design, construction, and testing of reactors and reactor components required for the solution of major problems in nuclear aircraft propulsion.

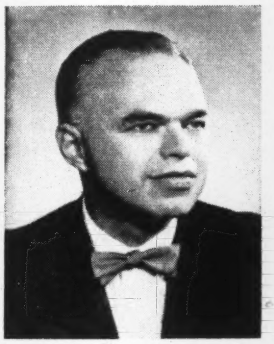
Mr. Cromer holds two U. S. Patents, and is the author of several technical papers. He is a member of the American Institute of Mining and Metallurgical Engineers and of Tau Beta Pi, honorary engineering fraternity.



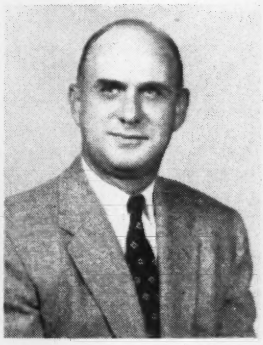
S. J. Cromer

The Blackall Machine Tool and Gage Award is awarded annually for the best paper dealing with machine tools, gages, or dimensional measuring instruments. It was presented for the first time in 1955.

THE BLACKALL AWARD
FOR A DISTINGUISHED CONTRIBUTION TO THE DESIGN OR APPLICATION OF MACHINE TOOLS GAGES OR DIMENSIONAL MEASURING INSTRUMENTS
ROBERT DOE JONES
1955



C. J. Oxford, Jr.



J. A. Cook

The Blackall Machine Tool and Gage Award

The Blackall Machine Tool and Gage Award is named for Frederick S. Blackall, jr., president and treasurer of the Taft-Peirce Manufacturing Company, who served successively as president of The National Machine Tool Builders' Association, in 1952, and as President of The American Society of Mechanical Engineers in 1953. It is awarded annually to the author or authors of such paper or papers deemed the best of those submitted to the Society on a subject clearly concerned with, or related to, the design or application of machine tools, gages, or dimensional measuring instruments. There is no limitation as to age, nationality, or Society membership.

The first award of the Blackall Machine Tool and Gage Award was made in 1955 at the ASME Diamond Jubilee Annual Meeting in Chicago, Ill.

C. J. Oxford, Jr., and J. A. Cook

The 1955 Blackall Machine Tool and Gage Award is conferred upon C. J. Oxford, Jr., and J. A. Cook for their paper, "The Influence of Tap-Drill Size and Length of Engagement Upon the Strength of Tapped Holes," presented at the 1954 Annual Meeting of ASME.

Carl J. Oxford, Jr., was born in Detroit, Mich. He attended Wayne University and the University of Michigan, receiving BSE and ME degrees from the University of Michigan.

From 1942 through 1945 he was employed by the Naval Aircraft Factory, Philadelphia, Pa., and in the Bureau of Aeronautics, Navy Department, Washington, D. C. In addition to handling special ordnance installations in naval aircraft, he later supervised research and development of aircraft and antiaircraft tow targets and handling equipment, and was engaged in the design of radar and proximity fuse targets.

In 1945 Mr. Oxford joined the National Twist Drill & Tool Company. Since 1952 he has been in charge of research, with special emphasis on metal cutting and related subjects.

Mr. Oxford is a registered professional engineer in the State of Michigan. He is a Member of The American Society of Mechanical Engineers, American Society of Tool Engineers, American Society of Metals, American Society of Testing Materials, Institute of Radio Engineers, National Society of Professional Engineers, American Society for Engineering Education, Tau Beta Pi, and Sigma Xi.

He is the author of a number of papers and articles in the field of metal cutting.

John A. Cook is a native of Philadelphia, Pa. He studied metallurgy at Wayne University. Mr. Cook has been employed by Winter Brothers Company, Crucible Steel Company of America, and National Twist Drill & Tool Company in various metallurgical and research positions.

In 1954 Mr. Cook joined the National Machine Products Company as research metallurgist, where he is currently concerned with various aspects of product development, quality control, and production.

He is a member of the American Society for Metals and of the American Society of Tool Engineers.

Prime Movers Committee Award

This annual award, established in 1954 from a fund donated by the Prime Movers Committee of the Edison Electric Institute, is conferred in recognition of outstanding individual or multiple-author contributions to the literature of

thermal electric-station practice or equipment.

The following are recipients of the 1955 Prime Movers Committee Award for their contributions to the "ASME Symposium on the Design and Operation of Outdoor Power Plants" at the Annual Meeting, December, 1953.

FRED W. ARGUE, Mem. ASME, is vice-president of Stone & Webster Engineering Corporation, Boston, Mass. He is the author of several technical papers and articles on steam and electric-power generation.

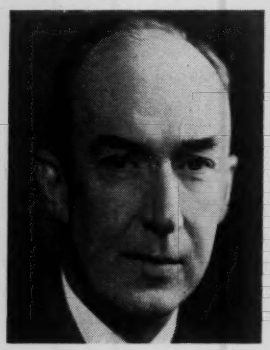
EDWARD C. DUFFY, Mem. ASME, has had wide experience in public utilities. He is currently vice-president in charge of gas and electric operations, engineering and construction at the Long Island Lighting Company.

LOUIS ELLIOTT, Fellow ASME, a consultant at Ebasco Services, Inc., New York, N. Y., has made many important contributions in the development of power-plant design.

WALTER F. FRIEND, Mem. ASME, mechanical engineer at Ebasco Services, Inc., New York, N. Y., is a consultant on electric-power generation and utilization for electric-utility companies, as well as technical adviser on atomic-energy development for power generation and industrial applications, and other research and development activities.

GUSTAF A. GAFFERT. The late Gustaf A. Gaffert, Fellow ASME, was one of the foremost designers of public-utility power plants in the United States. Mr. Gaffert died May 5, 1954.

BERNHARDT G. A. SKROTZKI is associate editor in charge of engineering and management for *Power*. Chairman of the Executive Committee of the Gas Turbine Power Division of ASME, he is author and coauthor of a number of papers presented before the ASME, the AIEE, the American Power Conference, and the World Power Conference.



F. W. Argue

E. C. Duffy

Louis Elliott

W. F. Friend

G. A. Gaffert

B. G. A. Skrotzki

ASME Junior Award

Ferdinand Freudenstein

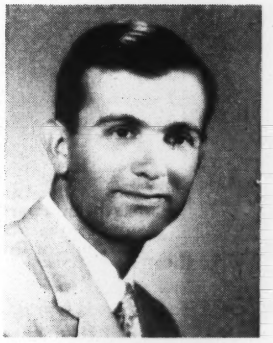
From a fund created in 1914 by Henry Hess, past vice-president of the Society, the Junior Award is presented annually to an Associate Member of the Society for an original paper submitted during the previous calendar year which is a distinct contribution to the literature of the profession of mechanical engineering.

For his paper entitled "Approximate Synthesis of Four-Bar Linkages," presented at the Fall Meeting of ASME in September, 1954, Ferdinand Freudenstein is the winner of this year's award.

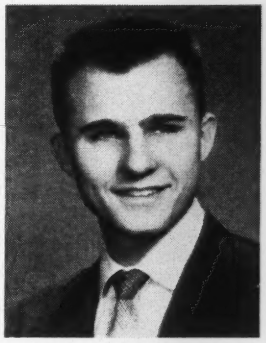
Mr. Freudenstein received his elementary schooling in Germany, where he was born, and his high-school education in England. He was awarded a BS degree from New York University in 1944. After two years of military service, during which he completed Army Specialized Training in Engineering at Texas A&M College, he received an MS in mechanical engineering in 1948 from Harvard University, where he studied under a Holzer scholarship.

Following two years as a development engineer in the Instrument Division of the American Optical Company, Buffalo, N. Y., he went to Columbia University in 1950 on a du Pont Fellowship, and received a PhD in mechanical engineering. During his period at Columbia he was employed part or full time as a military development engineer on automatic machinery, computing devices, and stress analysis on pressure vessels and piping. One of these positions was with Bell Telephone Laboratories at Whippany, N. J., as a member of the technical staff.

In September, 1954, Mr. Freudenstein



F. Freudenstein



R. J. Slember

N. R. Addonizio

joined the staff of Columbia University as an assistant professor in mechanical engineering. He is also a consultant to Bell Telephone Laboratories in Whippany, N. J. Besides his prize-winning paper he is the author of numerous others on four-link mechanisms.

Mr. Freudenstein, an Associate Member of The American Society of Mechanical Engineers, is also a member of the Harvard Engineering Society, Sigma Xi, and Pi Mu Epsilon.

Charles T. Main Award

Richard J. Slember

This award was established in 1919 from a fund created by Charles T. Main, past-president of the Society, to be awarded for the best paper within the general subject of the influence of the profession upon public life. The exact subject is assigned annually.

Richard J. Slember received a BS degree in mechanical engineering from Cooper Union School of Engineering in June, 1955.

After graduation he accepted a position with the Westinghouse Electric Corporation. He is at present employed at the Westinghouse Atomic Equipment Division in Chestwick, Pa., on a training assignment.

Born in Glen Head, Long Island, Mr. Slember was graduated from North Arlington, N. J., high school in June, 1951, prior to entering Cooper Union.

Mr. Slember is an Associate Member of ASME. While on the Westinghouse Graduate Student Course, he was elected secretary of the Graduate Student Club. He is a member of Pi Tau Sigma, to which he was elected during his senior year at Cooper Union.

The title of Mr. Slember's award-winning paper is "The Atom and the Mechanical Engineer."

The Charles T. Main Award was presented at the Members and Students Luncheon, Wednesday, November 16.

Undergraduate Student Award

Nino R. Addonizio

The Undergraduate Student Award, established in 1914 from a fund created by Henry Hess, past vice-president of the Society, is presented for the best paper or thesis submitted by a Student Member.

The recipient of the Undergraduate Student Award is Nino R. Addonizio. His award-winning paper is entitled "Analysis of Vibration Isolation for Vaneaxial Fans to Reduce Shipboard Noise."

Mr. Addonizio was born in Venticano (Avellino), Italy, in 1926. After graduation from classical high school in Italy in 1945, he joined the United States Army of Occupation in 1946, serving until his discharge in 1948.

Mr. Addonizio, who attends the Evening Division of Newark College of Engineering, is presently employed by Gibbs & Cox, Inc., New York, N. Y. He is a Student Member of ASME.

The Undergraduate Student Award was presented at the Members and Students Luncheon, Wednesday, November 16.

75th Anniversary Medallion

Incorporating a unique design of special significance at this time in our history, the ASME Diamond Jubilee Medallion is a fitting symbol for the important Anniversary it commemorates. Cast in bronze and measuring two inches in diameter, the obverse of the Medallion symbolizes the advances of 75 years in the generation of mechanical energy and their effect on the world in which we live. The reverse is adapted from the Society's symbol and is further enhanced by the Anniversary motto: "By Truth and by Service to Enrich Mankind."

Both symbol and motto were selected from entries submitted by ASME members in a nation-wide contest. Andrew T. Lemmens of Rochester, N. Y., created the winning symbol, and Dr. David H. Ray of North Tarrytown, N. Y., wrote the motto.

Artistic effectiveness was further ensured when the Medallic Art Company of New York City undertook the execution of the Medallion, and Joseph E. Renier, New York sculptor, was awarded the assignment. Mr. Renier has to his credit an impressive number of sculptured works, including seven metopes for the Postal Administration Building, Washington, D. C., and sculptures for the USS *Nautilus* and the *United States*. Mr. Renier has exhibited in leading galleries in this country.

The 75th Anniversary Medals, also of bronze and similar in design to the Medallion, have been awarded throughout 1955 within the various ASME Sections to members who have "done the most to further the aims and objectives of the Society." The 75th Anniversary Student Awards have been given to "the outstanding engineering student" at each college having an ASME Student Branch.

The Medallion in bronze is a handsome and useful memento which is available to members at Society Headquarters or at the registration area during general Society meetings.

In addition, special 75th Anniversary Medals were conferred upon Colonel L. F. Grant, Field Secretary of The Engineering Institute of Canada and President of the Engineers' Council for Professional Development; Harold S. Osborne, for-

The 75th Anniversary Medal has been awarded to outstanding Members of ASME Sections and Student Branches

mer Chief Engineer of the American Telephone and Telegraph Company and President of the International Electrotechnical Commission; and Thorndike Saville, Dean of Engineering, New York University, and President of Engineers Joint Council.

Le Roy Fraser Grant

Le Roy Fraser Grant, current president of Engineers' Council for Professional Development, has achieved wide success in many fields of work. Railway construction, land surveys, municipal projects, and irrigation schemes occupied him as a civilian. He has contributed to the development of engineering education in Canada while serving on the staff of two of their principal engineering colleges. He has served in the Canadian Army in both Great Wars, and was retired as a Lieutenant-Colonel in 1944.

Colonel Grant was graduated with honors from the Royal Military College, Kingston, Ontario, in 1905. Later, while teaching there in 1926, he received the degree of Bachelor of Science with honors from Queen's University. After an alternating career in the military service and in civilian life as an engineer, he became Associate Professor of Engineering on the faculty of applied science at Queen's University, Kingston, Ontario, on his retirement from the military service in 1944. Looking back on his career as an engineer, soldier, and professor, it is difficult to say which of these branches of work is the one in which he has been of greatest service to the engineering profession. Colonel Grant is a member and past-president of The Engineering Institute of Canada, and currently is on the staff of EIC as field secretary.

Harold S. Osborne

Harold S. Osborne, president of the International Electrotechnical Commission (IEC), received the 75th Anniversary Medal of The American Society of Mechanical Engineers at a special luncheon in The Engineers' Club, New York, N. Y., on October 18.

The medal was presented by Dr. David W. R. Morgan, ASME President, on behalf of that organization's Council. The citation accompanying the medal praised the recipient for "his splendid and outstanding leadership in IEC, and as its president."

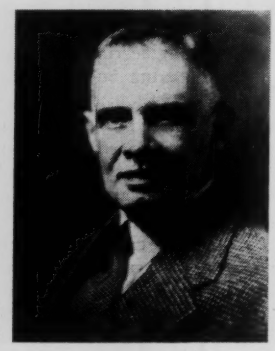
The International Electrotechnical Commission is an organization made up of the national standards bodies of 30 countries. It was organized in 1904 in response to the need for widely accepted standards in the electrical industry.

Dr. Osborne, who is 68, served as chief engineer of the American Telephone and Telegraph Company from 1943 until his retirement in 1952. He was chairman of the Exploratory Group on the Unity of the Engineering Profession, whose recommendations formed the basis for modification of Engineers Joint Council to broaden the base of its membership.

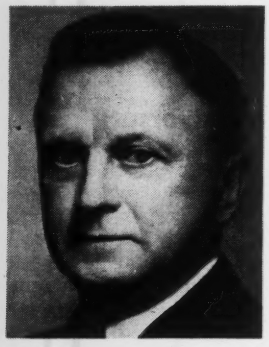
Active in civic life, Dr. Osborne is president of the Regional Plan Association, a quasi-public organization concerned with physical planning in the region around metropolitan New York, with membership among nearly 600 communities in three states. He is a member of the Town Commission of Montclair, N. J., and director of that town's Public Works Department.

Thorndike Saville

As an outstanding leader in the advancement of the engineering profession and of engineering education, Thorndike



L. F. Grant



H. S. Osborne

Thorndike Saville

Saville, Dean of Engineering at New York University, New York, N. Y., is eminently qualified to receive ASME's 75th Anniversary Medal.

Dean Saville joined the faculty of New York University in 1932 as professor of hydraulic and sanitary engineering, three years later becoming associate dean. In 1936 he was promoted to his present position. His policies at New York University have extended the range of undergraduate instruction, encouraged academic and sponsored research which enlarges the opportunities for advanced engineering education, at the same time adding to the store of scientific knowledge. His academic programs have done much to raise to major status the fields of sanitary science, meteorology, oceanography, and engineering physics.

As engineer and citizen, Dean Saville has devoted a lifetime to the conservation and judicious use of the nation's natural resources, particularly its water reserves. His early work in the statistical analysis of river flow proved valuable in flood control and river and stream-pollution projects. In 1926 the Rockefeller Foundation sent him as a consultant to the Government of Venezuela to investigate the water supply for Caracas.

In 1931 he wrote a comprehensive description of the power situation in the South in which he described the growth and future possibilities of hydroelectric developments in southern states, which was published by the American Academy of Political and Social Science. In 1936 he made an inventory of the nation's water resources.

He has originated, carried out, or directed studies in stream gaging, beach erosion, underground waters, rainfall, floods, evaporation, and silting. Subjects covered in his many publications include the administrative control of water pollution; methods of estimating flood flows; national planning for coastal protection; and the nature of color in water.

Dean Saville is a native of Malden, Mass. He received the BA degree from Harvard University and a BS, magna cum laude, from Dartmouth College, both in 1914. In 1915 he was granted the CE degree from Dartmouth's Thayer School of Engineering and in 1917 he was awarded the MS degree, both from Harvard and M.I.T. He received an honorary DE from Clarkson College of Technology in 1944, and from Syracuse University in 1951.

Dean Saville's efforts toward improving the status and quality of the engineer and his profession are reflected in a record of long and untiring service in numerous activities of the ASEE, the Engineers' Council for Professional Development of which he is president, and the ASCE. He was president of the ASEE in 1949-1950, president of the Metropolitan Section of ASCE in 1937–1943, and a director of the ASCE, 1945–1948.

75th Anniversary Awards•••

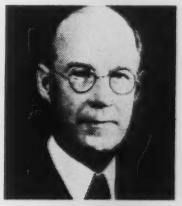
•••Presented to ASME Section Members and Students

A. B. Heiberg
Akron

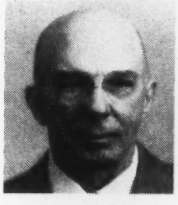
P. B. Eaton
Anthracite-Lehigh Valley

W. A. Biddle
Arizona

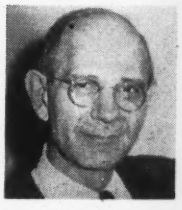
P. R. Yopp
Atlanta



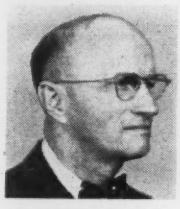
A. G. Christie
Baltimore



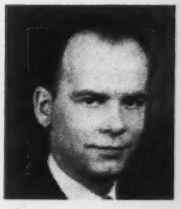
P. Wright
Birmingham



A. J. Ferretti
Boston

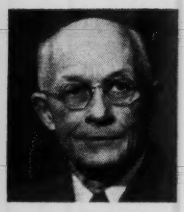


E. W. Allardt
Canton-Alliance-Massillon

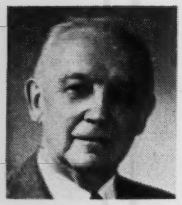


R. T. Mees
Central Illinois

A. A. Potter
Central Indiana

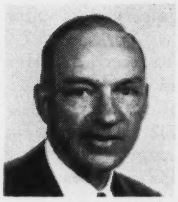


M. P. Cleghorn
Central Iowa



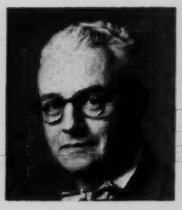
F. G. Hechler
Central Pennsylvania

M. E. Kirkpatrick
Central Savannah River Area



L. F. Pohl
Chattanooga

R. H. Bacon
Chicago



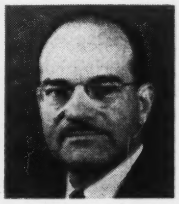
D. S. Brown
Cincinnati

Warner Seely
Cleveland

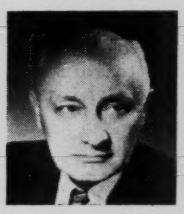
E. M. Johnston
Columbia Basin

J. B. Purdy
Columbus

E. W. Miller
Dayton



A. L. Glaeser
Delaware

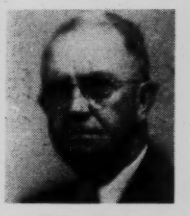


F. W. Lucht
Detroit

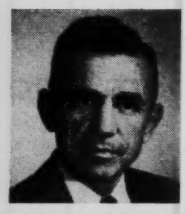
R. C. Robertson
East Tennessee

L. L. Vaughan
Eastern North Carolina

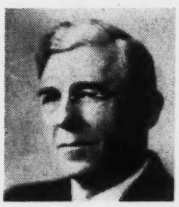
F. D. Mosher
Erie



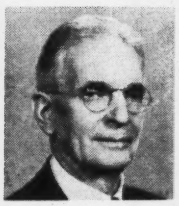
W. E. Hogan
Fairfield County



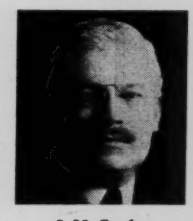
W. T. Tiffin
Florida



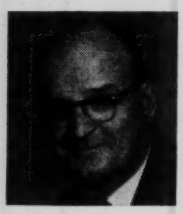
S. B. Earle
Greenville



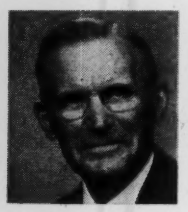
F. O. Hoagland
Hartford



S. N. Castle
Hawaii



N. F. Hindle
Inland Empire



C. A. Carlson
Iowa-Illinois

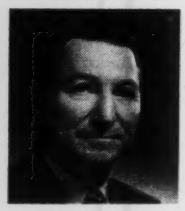
J. A. Keeth
Kansas City

Carl Handen
Mid-Hudson

H. R. Kessler
Metropolitan

J. M. Cabrera
Mexico

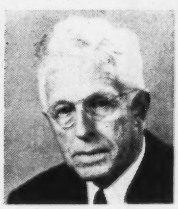
C. A. Stevens
Mid-Continent



G. V. Miniberger
Milwaukee

A. M. G. Moody
Minnesota

R. W. Mills
Nebraska



S. W. Dudley
New Haven

ASME Diamond Jubilee Awards ◆◆◆

S. L. Grapnel
New London

A. D. Ford, Sr.
New Mexico

L. J. Cucullu
New Orleans

C. H. Shumaker
North Texas

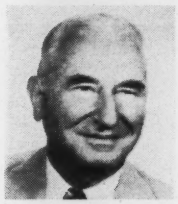
C. R. Davis
Ontario

B. G. Dick
Oregon

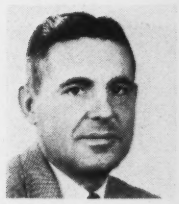
J. J. McCarthy
Philadelphia

E. E. Williams
Piedmont-Carolina

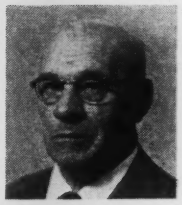
R. J. S. Pigott
Pittsburgh



P. Osterman
Plainfield



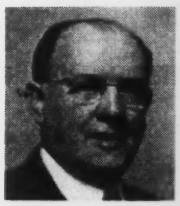
R. H. Stockard
Providence



A. E. Schell
Rochester

B. G. Elliott
Rock River Valley

R. F. Throne
Rocky Mountain



David Larkin
St. Louis

J. P. Hardway
San Diego

V. Estcourt
San Francisco

E. L. Robinson
Schenectady

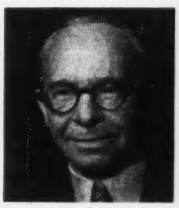
◆◆◆ to Outstanding Section Members

C. J. Eckhardt
South Texas

W. L. Chadwick
Southern California

H. A. Hendrich
Southern Tier

R. E. B. Sharp
Susquehanna



G. I. Vincent
Syracuse

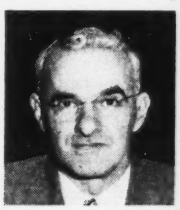
W. A. Stutske
Toledo

J. B. Jones
Virginia

H. H. Snelling
Washington, D. C.

C. M. Warner
Waterbury

T. Chandler
West Virginia



B. T. McMinn
Western Washington

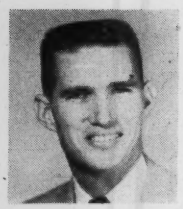
W. L. Kennicott
Westmoreland

Ollison Craig
Worcester

C. C. Womack
Youngstown

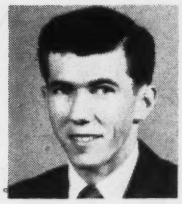
G. C. Ports
Univ. of Akron

G. P. Dunnavant
Alabama Poly Institute



R. O. Musgrove
Univ. of Alabama

R. A. Beam
Univ. of Arizona



L. J. Girad
Univ. of Arkansas

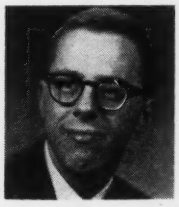
R. Hecker
Bradley University

R. M. Brown
Univ. of British Columbia

J. E. Motherway
Brown University

R. A. Wilson
Bucknell University

J. L. Adams
California Institute of Technology



R. du Plessis
Univ. of California

J. E. Meyer
Carnegie Institute of Technology

ASME Diamond Jubilee Awards ♦♦♦

♦♦♦ to Outstanding Engineering Students

W. Thomas
Case Institute of Technology

E. Wedbush
Univ. of Cincinnati

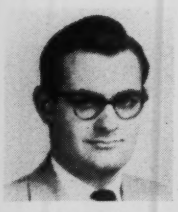
R. Dow
Clarkson College of Technology

W. H. Hendrix
Clemson Agricultural College

W. W. Wilmore
Colorado A&M College

H. E. Kellogg
Colorado School of Mines

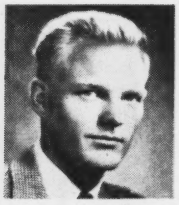
B. W. Brown
Univ. of Colorado



C. Yanis
Columbia University

B. R. Thompson
Univ. of Connecticut

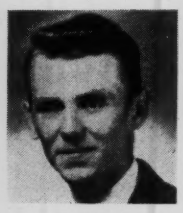
H. N. Luhrs
Cooper Union School of Engineering



R. V. Kahle
Cornell University

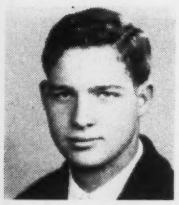
J. E. Minardi
Univ. of Dayton

A. J. Holveck
Univ. of Delaware



R. J. Bok
Univ. of Denver

R. Harig
Univ. of Detroit



R. L. Glazier
Drexel Institute of Technology

D. P. DeWitt
Duke University

E. A. Capadona
Fenn College

J. Anderson
Univ. of Florida

C. A. Kennedy, Jr.
George Washington University

E. M. Austin
Georgia Institute of Technology

T. R. Frostenson
Univ. of Idaho

D. Savitt
Illinois Institute of Technology

H. R. Hirsch
Univ. of Illinois

R. Stanley
Iowa State College

E. H. Young, Jr.
The Johns Hopkins University

E. T. Hart, Jr.
Kansas State College

D. H. Harrison
Univ. of Kansas

R. F. Dickson
Univ. of Kentucky

A. R. Bartolacci
Lafayette College

C. E. Brady
Lehigh University

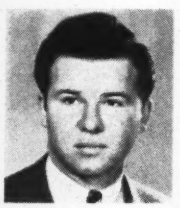
W. H. McCasland
Louisiana Polytechnic Institute

B. J. Walker
Louisiana State University

D. L. Brown
Univ. of Louisville

J. Chapin
Lowell Technological Institute

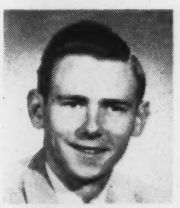
L. F. Sander
Marquette University



J. E. Goeller
Univ. of Maryland

H. K. Hebeler
M.I.T.

R. O. Bagley
Univ. of Massachusetts



J. W. Kytola
Michigan College of M&T

R. Redman
Michigan State College

T. N. Khoury
Univ. of Michigan

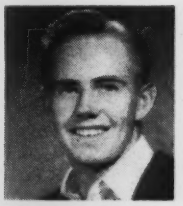
H. H. Hillman
Univ. of Minnesota

C. T. Carley, Jr.
Mississippi State College

J. B. Miles
Missouri School of Mines and Metallurgy

D. Crawford
Univ. of Missouri

M. C. Fisher
Univ. of Nebraska



J. J. Carlson
Univ. of Nevada

H. Schnitzer
Newark College of Engineering

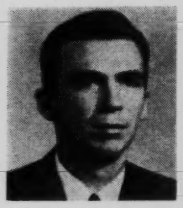
D. W. Melvin
Univ. of New Hampshire

R. F. Chandler
Univ. of New Mexico

L. Sugin
College of the City of New York

D. Marcus
New York University

P. Maccari
New York University (Evening)



R. E. Johnson, Jr.
North Carolina State College

G. B. Child
North Dakota Agricultural College

J. N. Sorensen
Univ. of North Dakota

N. Slack
Northeastern University

N. E. Bartelt
Northwestern University

A. R. Barlow
Norwich University

G. E. Schoenherr
Univ. of Notre Dame

J. E. O'Neil
Ohio State University

B. E. Bader
Ohio University

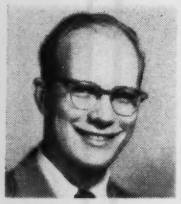
J. D. Parker
Oklahoma A&M College

R. H. Paapanen
Univ. of Oklahoma

F. A. Olson
Oregon State College

G. E. Kulynych
The Pennsylvania State University

R. Bullis
Polytechnic Institute of Brooklyn



A. R. Schroter
Polytechnic Institute of Brooklyn (Evening)

J. B. Smedfjeld
Pratt Institute

R. M. Barr
Princeton University

M. P. Velez
Univ. of Puerto Rico

T. W. DeVries
Purdue University

R. T. Vandervelde
Queen's University (Ontario)

A. B. Schultz
Univ. of Rochester

R. A. Llewellyn
Rose Polytechnic Institute

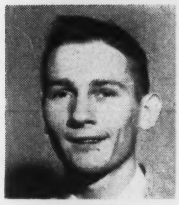
G. D. Leal
Univ. of Santa Clara

W. L. Edens
Univ. of South Carolina

O. P. Bak
South Dakota School of M&T

C. O. Pedersen
South Dakota State College

W. L. Crawford, Jr.
Southern Methodist University



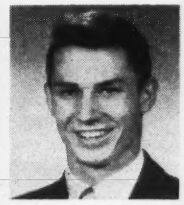
E. Hess
Stevens Institute of Technology

R. Levien
Swarthmore College

D. C. Rupley
Univ. of Tennessee

D. L. Barksdale
A&M College of Texas

W. D. Burton
Texas Technological College



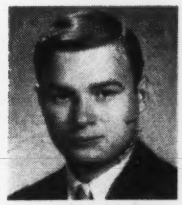
T. L. Tyler
Thayer School

J. N. Rosall
Univ. of Toronto

R. C. Bryant
Tufts College

E. W. Vendell, Jr.
Univ. of Utah

J. Suggs
Vanderbilt University



J. W. Distel
Villanova College

J. W. Young, Jr.
Virginia Polytechnic Institute

R. W. Wallenborn
Univ. of Virginia

T. L. Kick
Washington University

U. Lapins
Univ. of Washington

R. Thorne
Wayne University

R. D. Teter
West Virginia University

C. C. Rands
Univ. of Wisconsin

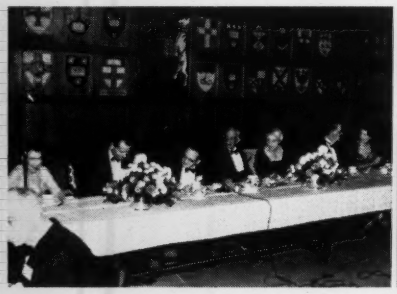
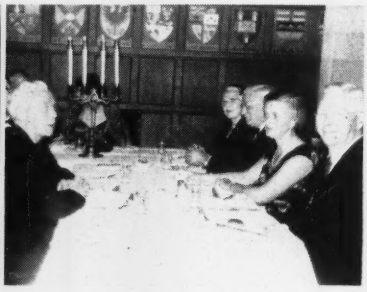
C. E. Nord
Worcester Polytechnic Institute

L. D. McCoy
Univ. of Wyoming

E. R. MacCormac
Yale University

ASME NEWS

With Notes on the Engineering Profession

Head table at annual dinner of the Engineers' Council for Professional Development, held during the 23rd Annual Meeting, in Toronto, Ont., Can., October 13 and 14. M. D. Hooven, vice-president, ECPD, and president, AIEE, presided.

Survey of Engineering Profession Proposed at 23rd Annual Meeting of ECPD

Panels on important engineering topics, addresses by prominent educators, Survey of Engineering Profession, student development, and ASME report make up schedule

TORONTO, Ont., Can., was the scene of the 23rd Annual Meeting of Engineers' Council for Professional Development on Oct. 13 and 14, 1955, at which there was unanimous approval of a resolution:

1 That the Council "sponsor a survey of the engineering profession to include the present and prospective needs for engineering services, the improvement in the utilization of engineers and supporting technical personnel, the scope and nature of the education and training required, the problems of registration, unionization, and ethics involved, and all other matters pertinent to determine the most effective organization of the profession to meet its public responsibilities and professional opportunities";

2 That the Council "seek the concurrence of its constituent societies in undertaking such a survey"; and

3 That the Council "refer this resolution to its Executive Committee for implementation."

High Lights of Meeting

Other high lights of the meeting were the addresses delivered by S. C. Hollister, C. T. Bissell, and R. G. Warner; forum-type discussions of ethics, the proposed survey of the engineering profession, and student development; the presentation of reports of committees; and the election of officers. Announcement of the newly elected officers will be found on page 1154 of this issue.

Arrangements for the meeting were made by a Host Committee of Canadian engineers and a Ladies Committee provided entertainment for women guests. It is estimated that about 200 persons attended the meeting.

The General Program

The general program followed the pattern of former gatherings. On Thursday morning meetings of the Council and several of its standing committees were held. At a luncheon at which Col. L. F. Grant, president, ECPD, presided and R. E. Heartz, president, The Engineering Institute of Canada, welcomed the guests, S. C. Hollister, dean, College of Engineering, Cornell University, in an address which appears in full on pages 1053-1055 of this issue, proposed a survey of the engineering profession.

After the luncheon there was an open meeting of the Council. Reports of the president, the standing committees, and the representatives of the constituent societies were presented. These reports, with the exception of the list of accredited curriculums and the finance report, had been printed in advance and were available for study. The revised reports in complete form will be available about the first of the year.

C. T. Bissell Addresses Annual Dinner

Prior to the annual dinner on Thursday evening the guests attended a reception and cocktail party given by The Engineering Institute of Canada. M. D. Hooven, vice-president ECPD and president American Institute of Electrical Engineers, presided at the dinner. Past-presidents of ECPD and representatives of local engineering societies were introduced. The address was delivered by C. T. Bissell, vice-president, University of Toronto. The newly elected president of ECPD, Thorndike Saville, dean, College of Engineering, New York University, was introduced.

After some words of welcome and a tribute to the universities of the United States and Canada and to ECPD, Dr. Bissell said that "it would be a pity if the center of educational thought were to shift from the universities themselves to any outside body, no matter how wise and reputable that outside body might be." Speaking as a Canadian he asserted that "we are suspicious of the system of accrediting by outside organizations. In most cases there can be no doubt of the wisdom of those who carry out accrediting of universities, and it is not the bodies concerned with accrediting that we would challenge. It is rather the implications of the system for the university."

Dr. Bissell quoted President Dodds' reference to a "multiversity" by which was meant "a congeries of separate faculties and institutes, each concerned with some immediate goal and unrelated to any central purpose.....This tendency toward fragmentation," he said, "must be resisted. I think we can resist it in the university by a constant emphasis upon the aims of higher education common to all departments and divisions—in other words, the fundamental unity of knowledge." It was unfortunate, he stated, that there should be such a marked distinction

drawn between professional and liberal education. "All education," he asserted, "is professional in the sense that it seeks to combine certain general qualities of mind and heart with the mastery of a specific area of knowledge. That area of knowledge, of course, varies from faculty to faculty in accordance with its immediate relation to everyday living. But whether it involves a knowledge of the scansion of Greek verse or the principles of hydraulics, it is still a specialized area of knowledge."

He recalled that "professionalism has a long and honored history in the development of the university," and cited Bologna's law school, the medical center at Salerno, and the theological schools of Paris. Professionalism in those early universities, he said, always involved the close interrelation between specialized knowledge and general qualities of mind. Professional schools "must never lose sight of the importance of the general qualities of mind that should be common to all faculties," such as "incisiveness of expression, powers of organization and of logical thought, and in willingness to reserve conclusions until the facts are all in, and their correlatives on the side of character: tolerance, humility, and empathy."

Dr. Bissell spoke about the place the humanities and social sciences should occupy in the curriculum of the engineering student and suggested two ways of meeting the difficulty: 1 A pre-engineering year or two which "in addition to giving instruction in the humanities and social sciences, emphasizes the basic natural sciences that an engineer needs"; 2 "bringing back graduates in engineering to the university for a concentrated course in the humanities and social sciences after they have had a few years' experience in the profession."

"In Canada and the United States," Dr. Bissell said, "we have made engineering education almost entirely a university concern. In Europe and Great Britain there has been . . . a distinction between engineering training in the universities and engineering training in the technological institutes . . .. Is there not a likelihood," he asked, "that many of the students who now find their way into universities should be encouraged to go to such institutes?"

"In this way," he argued, "we shall salvage something of the great waste which occurs in the first year of our engineering courses as a result of the student's inability to cope with theoretical disciplines. We shall ensure that our universities are concerned with their proper task—the training of keen minds on fundamental principles. And we shall be making a discerning contribution to the problem of numbers and the university."

Practice of Engineering

At the Friday luncheon, Col. L. F. Grant, presiding, Russell G. Warner, representative on ECPD of the National Council of State Boards of Engineering Examiners, chairman, ECPD Recognition Committee, and chairman, joint ECPD-EJC Committee on Practice of Engineering, spoke on professional aspects of the practice of engineering. Mr. Warner discussed the high ethical standards essential to a profession, the responsibilities of employers in developing young engineers in professional attitudes and growth, and the question of the practice of engineering by corporations. The text of Mr. Warner's address will be published in a future issue of MECHANICAL ENGINEERING.

Panel Discusses Ethics

Scott Turner, chairman, ECPD Ethics Committee, presided at a panel discussion on ethics at the Friday morning session. Participating in the panel were: T. A. Boyle, assistant professor of mechanical and industrial engineering, University of Michigan, Ann Arbor, Mich.; N. A. Christensen, director, School of Civil Engineering, Cornell University, Ithaca, N. Y.; N. W. Dougherty, dean of engineering, University of Tennessee, Knoxville, Tenn.; Dean G. Edwards, consulting engineer, Newark, N. J.; C. J. Freund, dean of engineering, University of Detroit, Detroit, Mich.; G. Ross Lord, professor of mechanical engineering, University of Toronto, Toronto, Can.; J. E. L. Roy, chief engineer, auxiliary services, Quebec-Hydro-Electric Commission, Montreal, Can.; and W. Stewart Wilson, assistant dean and secretary of the Faculty of Engineering and Science, University of Toronto, Ont., Can.

The following summary of the discussion is based on notes provided by Dean Freund:

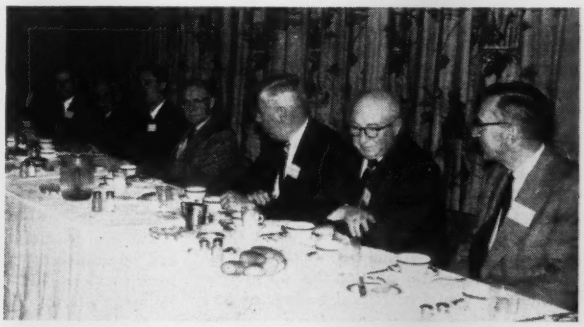
Mr. Turner reviewed the history of the ECPD Canons of Ethics, which was a project originally undertaken by the American Engineering Council. After discussion and debate the Canons were organized by ECPD in their present structure of 28 sections which have now been accepted or endorsed by 82 national, regional, and local engineering societies. Mr. Turner defined ethics as the science of moral conduct and briefly traced the evolution of ethics from primitive to modern civilizations.

Professor Boyle discussed the teaching of ethics in the light of modern pedagogical and psychological standards. He explained what is meant by learning by attitude and learning by value judgments and pointed out that learning by value judgments is required for instruction in ethics. Experience, he said, is needed for teaching by this method. He explained the need for norms for the appraisal of the teaching of ethics and stated that group discussion is better than lectures for attitude learning. It was his opinion that the teaching of ethics is not feasible by the use of quantitative methods familiar in engineering, and that engineering teachers might demonstrate ethical principles by their care in appraising the academic work of students.

Professor Christensen defined individual ethics as pertaining to moral conduct and professional-engineering ethics as seeking the promotion of the good influence of engineering in the community. He traced the Golden Rule through the teachings of a number of the important historical and world religions and philosophies. It was his opinion that the engineering profession does not adequately understand or appreciate the importance of ethics, and he cited cases in the development of uranium properties in violation of good ethics. He proposed competitions among student and junior engineers in the solving of ethical problems, statements of the problems to be obtained from state boards of engineering examiners and from committees on professional practice and ethics of the various societies.

Dean Dougherty expressed the opinion that engineers probably have an excellent reputation for good ethics in part because they have to do with the laws of nature with which they cannot tamper. He suggested that ethics might be learned both by environment

View of head table at an ECPD Luncheon held during the 23rd annual meeting. L. F. Grant, president of ECPD, presided.



R. G. Warner, NCSBEE representative, delivered an address entitled "Professional Aspects of the Practice of Engineering."

and by formal instruction. Formal courses were of value at least for supplying information, he said, since knowledge of ethics alone will not make an engineer ethical; he must also be motivated. Good ethical conduct in the faculties was, in his opinion, of value as a potent device for imparting both understanding and motivation to students.

Dean Freund suggested that it was not easy to understand just what was meant by a profession, engineering or any other. It was his opinion, formed following much reading, study, and discussion, that the principal characteristic of the professional man was that he commands the confidence of the people who retain or engage him because of his competence and integrity. The professional man differs from a high-grade tradesman, he said, in that the layman can neither attain to, nor even comprehend, the professional man's competence and skill. A county board, he asserted, will not engage an engineer to design a bridge unless they know that he is honest and upright and that he has a cultivated moral judgment. In other words, he must be ethical.

Mr. Roy discussed several ethical questions. First of these was the ethical position of the engineer who undertakes outside work in addition to his regular job. Although younger engineers are well paid, older men are frequently tempted to engage in supplementary occupations to build up their income, he said. Corporations and other employers incline to encourage this by permitting older engineers to stagnate, and by giving them work to do which is more appropriate to technical-institute graduates. He raised the question whether engineers should testify in court actions pertaining to the negligence of fellow engineers. He explained that physicians will not so testify and that such testimony is unethical. He insisted that the profession itself must discipline its delinquent members. He discussed the case of engineers appointed to a board to review the claims of a contractor against an owner when the engineers had been employed by the contractor and had even helped him to prepare his case before the board. In spite of tendencies in the opposite direction, he believed that ethical standards are improving and that the highest aspirations and ideals are attainable.

Mr. Edwards reviewed the meaning of ethics to employers and pointed out, from that viewpoint, the difference between the Canons of ECPD and the codes of the several societies. He noted that the employing engineer is in a difficult position under the Canons because he must explain his competence in order to obtain work to do, but at the same time may not advertise. An anomaly exists when a manufacturer may advertise the machinery he produces but an engineer may not claim public credit for the design of that machinery. On the other hand, many employers do not live up to the Canons because they fail to pay adequate salaries to engineers even when their financial condition would permit them to do so. He expressed the opinion that a majority of engineers would be ethical because of personal integrity even if they knew nothing about the Canons of ECPD or the societies' codes.

Professor Lord explained the function of the codes of the Canadian professional societies in the legal supervision of engineering practice in the Province of Ontario. He distributed copies of the Code of the Ontario Association of Engineers. The Council of this association, he said, is a court of inquiry in the matter of ethics violation and engineers may engage legal counsel in actions before this court. He reviewed the difficulty of administration of ethical codes and felt that the societies could accomplish more by promoting ethics than by the discipline of those who violate the codes.

Dean Wilson spoke briefly on the subject of the Ritual of Calling of an Engineer as a very strong influence in imparting to Canadian engineering students an understanding of professional ethics.

Survey of the Engineering Profession

On Friday afternoon, an open forum discussion was conducted on the proposal for the survey of the engineering profession, outlined by Dean S. C. Hollister at the luncheon meeting of October 13. (See pages 1053–1055 of this issue.) The discussion was led by the following panel: W. L. Everitt, dean of engineering, University of Illinois; R. M. Hardy, dean of engineering, University of Alberta, Edmonton, Canada; M. D. Hooven, electrical engineer, Electrical Engineering Department, Public Service Electric & Gas Company, Newark, N. J.; H. N. Meixner, staff assistant, engineering department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.; Thorndike Saville, dean of engineering, New York University; and Warren L. McCabe, administrative dean, Polytechnic Institute of Brooklyn, who presided, to whom we are indebted for the following summary.

The purpose of the meeting was to discuss the Hollister proposal for a comprehensive survey of the engineering profession. The discussion was started by asking a series of basic questions about the proposed survey.

Answers to the questions were given by members of the panel. After these initial questions were answered, the proposal was thrown open to the general questioning and comment from the audience. A summary of the answers to the questions follows:

The proposed survey is not another study of engineering education itself. Such a restricted survey following immediately upon the excellent job that has just been completed by the Evaluation Committee of ASEE would be completely unnecessary. The proposed survey, although it would include education within it, should cover all aspects of the engineering profession, the circumstances surrounding its activities, and should chart its course for the future. The specific topics around which the survey might be constructed, prepared by Dean Saville, were read.

The survey should involve both engineers and nonengineers. Quoting from Dean Hollister's address, "It would seem appropriate to set up an advisory board from the engineering profession to give guidance to the inquiry itself. This board should represent different elements of the structure of the profession and different ways in which these elements function. It should be as small and compact as possible. It should report to this Council."

The personnel conducting a survey of this magnitude should include various experts and professional interviewers and any other personnel that might contribute to the success of the survey. The task-force technique would probably be of considerable service.

An accurate estimate of cost of the survey cannot be made now but the expense would probably be of the order of the magnitude of a million dollars. It is not possible for the constituent bodies of ECPD to completely finance an undertaking of this sort but they should be expected to contribute. With reasonable contributions from the ECPD bodies, the bulk of the support must come from foundations or industry.

The ASEE evaluation report had to do with education only. It was devoted primarily to undergraduate engineering education with some attention paid to graduate work. The area of the ASEE evaluation report is only a small portion of that planned for the proposed survey. Also, the evaluation committee preparing its report ran head on into a number of unsolved problems and undetermined issues that limited its activities and inhibited, to some extent, the conclusions that might be drawn from the evaluation study.

The following quotation from the Hollister address explains why the entire profession rather than a study of it, branch by branch, should be undertaken:

"It has been suggested that each of the professional branches should undertake a study upon its own. One only needs to recall the interweaving of the services of the separate branches, the extent to which they have a relative common background, the fact that in many cases their talents and efforts impinge upon the same general problem, and the fact that many trained in one branch actually serve, through their professional lives, in another branch, to realize that there would be duplication, waste of effort, waste of money, and in general, unnecessary confusion if the study were to be made in that manner. Furthermore, it seems to me that such a study needs background that can be obtained only through the guidance of an organization whose principal objective is the development of the engineering profession in all aspects. Clearly then, the sponsor for such an operation should be the Engineers' Council for Professional Development."

It is recognized that specific attention must be paid in the survey to the individual engineering branches. This can be done by appropriate organizations of task forces and teams of specialists qualified to evaluate the individual characteristics of the engineering profession including those of the branches engineering.

Cognate fields such as the physical sciences and the humanistic and social disciplines should be brought into the survey in so far as they affect important aspects of engineering. Since engineering is constantly becoming more scientific and more scientists are becoming engineers, the physical sciences and their impact on engineering are important elements in the study. The same statements can be

made with respect to humanistic and social disciplines. These should not be studied in their own right but they cannot be ignored in a study of engineering.

On the question, What benefits may be anticipated from this survey? the following is quoted from the Hollister address:

"It would seem clear that everybody stands to gain by a well-executed study of this sort. First of all, the community would be served by any improvement that could be brought about in the functioning of our important profession. Those immediately concerned with function, namely, the employers of engineers and the engineers themselves, would profit both individually and collectively by such a well-designed and well-executed survey. And finally, such a survey should lay the groundwork for improvement and better definition of the engineering profession as a whole."

A survey of this type properly conducted and implemented on the basis of sound recommendations developed therein should place the engineering profession on a much more solid foundation than at present. It should position the profession to render improved service to the body politic which is the only excuse for a profession in the first place. Advantages that accrue to the profession itself from such a reorientation and rededication of its function would be real but secondary.

After discussion of the foregoing subjects, a general discussion was conducted in which many of the audience participated actively. A number of questions were asked and discussed. Without attempting to bring in all questions, some of the important were as follows:

Should foreign engineering be considered? The consensus was that engineering in Canada should be studied and information obtainable on European engineering, pertinent to the survey, should be assembled.

Should the survey consider the reorganization of the profession? The answer was yes.

Should the study lead to definite recommendations? The consensus was that strong recommendations should result from the study and that these recommendations should be put into effect.

Should a pilot study be made of one branch of the profession? The consensus was that such a pilot study, so defined, was not necessary. On the other hand, a pilot study designed to outline the boundaries of the problem and to establish a sound procedure of operating might be decidedly worth while. Such a pilot study might be required by foundations planning to support the program and this pilot study might be financed wholly, or in part, by the engineering profession itself.

How are fractions of the profession, not now represented by ECPD, to be handled? Although ECPD is the logical agency for conducting this survey, the survey should clearly involve all elements of the profession including those not now represented in ECPD itself.

Other aspects of the survey came out during the discussion. It was suggested, for example, that the survey be suitably long range; that the utilization viewpoint take precedence over the educational viewpoint; and that a major objective of the survey be to establish engineering as a better profession in terms of public service than any other profession now active.

Student Development Discussed

The ECPD Student Development Committee under the chairmanship of N. W. Dougherty, dean of engineering, The University of Tennessee, Knoxville, Tenn., conducted a session on Friday afternoon at which some of the subjects of interest to the committee were discussed. Dean Dougherty reviewed the problem of awakening professional consciousness in engineering students and the question of teaching preparation for professional practice.

Although there is "a general feeling that professional attitudes cannot be taught, that they are caught like measles and mumps, and that formal courses are not necessary," he said, "we must accept the conclusion that any knowledge which can be identified and classified can be taught. All the background, the rules, and the actual canons of professional practice have been written and can be amplified," he contended. "These certainly may be taught. Motivation to do good and to practice according to professional tenets is the more difficult problem. Attitudes may be transmitted by contact and contagion, but this does not preclude formal courses which delineate the needed knowledge.

"The more-experienced teacher realizes that it is much easier to teach facts and laws than to teach attitudes and approaches," he said in conclusion. "The one can be measured by test and examination, but the other may be intangible and difficult to measure. Motivation is the key to any good which may come from such study, and there is no easy way to measure the results of the teacher's efforts at motivation. It may not appear until the course is forgotten and the student has become a man on a job infested by politicians or other species who expect to live without too much hard work."

Report of ASME Representatives on ECPD

The report of ASME representatives on ECPD (W. F. Ryan, A. C. Monteith, and H. N. Meixner) follows:

During the past year the Society has been devoting a large amount of time and attention to supporting the efforts of ECPD to raise the standards of engineering education, particularly in mechanical engineering. At the Annual Meeting on Monday, Nov. 29, 1954, the ASME Education Committee conducted a full day's discussion of accreditation and the mechanical engineer. This discussion was led by Dean Harold L. Hazen, chairman of the ECPD Education Committee; Chalmers G. Kirkbride, president of the American Institute of Chemical Engineers, long active in the chemical engineers' efforts to support chemical-engineering education; Jess H. Davis; Karl B. McEachron, Jr.; and S. C. Hollister. The discussion was well attended and progress was made in clarifying the responsibility of the Society in the educational process and in explaining the importance of accrediting to practicing members of our profession.

As a result of this panel the Education Committee set up a committee to prepare a policy and procedure for the nomination of mechanical engineers to serve on inspection committees of ECPD. This policy and procedure were approved by the ASME Education Committee on June 20, 1955, at a meeting in Boston, Mass. Also, at the Boston meeting, the committee considered suggestions which would give the ASME a larger opportunity to be helpful in the accrediting program of ECPD.

The interest of the Education Committee in improving engineering curriculums received support from the ASME Committee on Society Policy, which recommended to the Executive Committee that the Education Committee be encouraged to assume aggressive leadership toward improving the standards of education within the field of mechanical engineering in educational institutions and in training courses in industry, and to submit reports and recommendations toward these ends through the Board on Education and Professional Status for review by the ASME Council. In transmitting this action to the Committee on Education, the Board on Education and Professional Status voted that the problem be transmitted with the statement that it is the Board's understanding that "aggressive leadership" does not mean superseding in any way the present activities of ECPD, but does imply strengthening and intensifying ECPD's work within the scope of ASME activities.

During the year the Society supported the activities of the ECPD Guidance Committee, purchasing and distributing a large number of the pamphlet prepared by the Committee entitled, "After High School What?"

In further support of the educational program of ECPD, ASME jointly with The Engineering Institute of Canada held a convocation with the co-operation of Clarkson College of Technology at Potsdam, N. Y., in October, 1954, at which technical-engineering curriculum and over-specialization were discussed at length.

Nominations for ASME Honors Sought

MEMBERS and agencies of The American Society of Mechanical Engineers including the Council, Boards, Committees, Sections, and Professional Divisions are invited to submit nominations for Society awards (see pages 1126–1137 of this issue). Nominations for 1956 awards must be in the hands of the Board on Honors prior to March 1, 1956.

It is essential that those wishing to make a nomination should first obtain a copy of the ASME Honors Manual, MS-71. This is available by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

ASME Calendar of Coming Events

March 14–16, 1956
ASME Aviation Division Conference, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers was Nov. 1, 1955)

March 14–15, 1956
ASME Engineering Management Conference, Hotel Statler, St. Louis, Mo.
(Final date for submitting papers was Nov. 1, 1955)

March 18–21, 1956
ASME Spring Meeting, Multnomah Hotel, Portland, Ore.
(Final date for submitting papers was Nov. 1, 1955)

March 26–27, 1956
ASME Instruments and Regulators Division Conference, Princeton University, Princeton, N. J.
(Final date for submitting papers was Nov. 1, 1955)

April 1–5, 1956
ASME Oil and Gas Power Division Conference, Jung Hotel, New Orleans, La.
(Final date for submitting papers was Dec. 1, 1955)

April 10–11, 1956
ASME Machine Design Division Conference, Bancroft Hotel, Worcester, Mass.
(Final date for submitting papers was Dec. 1, 1955)

April 16–17, 1956
ASME Gas Turbine Power Division Conference, Hotel Statler, Washington, D. C.
(Final date for submitting papers was Dec. 1, 1955)

May 8–11, 1956
ASME Metals Engineering-AWS Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers—Dec. 31, 1955)[5]

May 23–25, 1956
ASME-EIC Meeting, Mount Royal Hotel, Montreal, Que., Can.
(Final date for submitting papers—Dec. 31, 1955)

June 14–16, 1956
ASME Applied Mechanics Division Conference, University of Illinois, Urbana, Ill.
(Final date for submitting papers—Feb. 1, 1956)

June 17–21, 1956
ASME Semi-Annual Meeting, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers—Feb. 1, 1956)

Sept. 10–12, 1956
ASME Fall Meeting, Denver, Colo.
(Final date for submitting papers—May 1, 1956)

Sept. 17–21, 1956
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Coliseum, New York, N. Y.
(Final date for submitting papers—May 1, 1956)

Sept. 23–26, 1956
ASME Petroleum-Mechanical Engineering Conference, Conrad Hilton Hotel, Dallas, Texas
(Final date for submitting papers—May 1, 1956)

Oct. 8–10, 1956
ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers—June 1, 1956)

Oct. 24–25, 1956
ASME-AIME Joint Fuels Conference, Sheraton-Park Hotel, Washington, D. C.
(Final date for submitting papers—June 1, 1956)

Nov. 25–30, 1956
ASME Annual Meeting, Hotel Statler, New York, N. Y.
(Final date for submitting papers—July 1, 1956)
(For Meetings of Other Societies, see page 1152)

AAAS Section-M Program Announced, Atlanta, Ga., Dec. 26–31

THE preliminary announcement of the Section-M of the second Atlanta, Ga., meeting, December 26–31, of The American Association for the Advancement of Science was published recently.

Attention is called to challenging problems involved in the restoration of function to individuals with paralysis or amputation to be discussed by leading authorities as part of the 122nd AAAS meeting. At morning and afternoon sessions in the Atlanta Municipal Auditorium on Friday, December 30, new developments in orthopedic braces will be discussed from the medical and engineering viewpoints.

Of particular novelty will be presentations of the little-known economic aspects of the brace and artificial-limb industries, according to Eugene F. Murphy, Assoc. Mem. ASME, chief, Research and Development Division of the Veterans Administration's Prosthetic and Sensory Aids Service, who is organizer of this symposium.

The Atlanta Meeting Program Committee of Section-M consists of the following personnel: Mario J. Goglia, Mem. ASME; H. McKinley Conway, Jr., editor, *Industrial South;* Roger Kearton, Lockheed Aircraft Corporation, Marietta, Ga.; E. W. O'Brien, past-president and Fellow ASME; and Earle Rauber, Federal Reserve Bank. The preliminary program follows:

TUESDAY, DECEMBER 27

9:00 a.m. Georgian Terrace Hotel

Symposium: Automation 1

Panelists:

Frank F. Groseclose, director, School of Industrial Engineering, G.I.T.

Lillian M. Gilbreth, Montclair, N. J.

James Stearn, staff consultant, UAW-CIO Automation Committee

Adam Abrassi, Stevens Institute of Technology

12:30 p.m. Empire Room, Biltmore Hotel

Luncheon

Presiding: *Frank Neely,* Rich's Inc.

Speaker: *Frank J. Soday,* vice-president, Chemstrand Corp.

Subject: **The Increasing Importance of Science and Technology in Southern Industry.**

2:30 p.m. Rich Computer Center, Georgia Institute of Technology

Symposium: Automation 2

Presiding: *E. K. Ritter,* chief, Rich Computer Center, G.I.T.

A tour of the Computer Center will be followed by a discussion of computers by the staff.

WEDNESDAY, DECEMBER 28

9:30 a.m. Georgian Terrace Ballroom

Symposium: Resource Development Through Science 1

(For details of this symposium, see program of Section P, Industrial Science, to be distributed at the meeting.)

12:30 p.m. Empire Room, Biltmore Hote

Luncheon

2:00 p.m. Georgian Terrace Ballroom

Symposium: Resource Development Through Science 2

2:00 p.m. Atlanta Division, Atlanta University

Conference on Scientific Manpower

(For details of this program, see program of X5, Conference on Scientific Manpower, distributed at the meeting.)

THURSDAY, DECEMBER 29

9:00 a.m. Plaza Room, Dinkler Hote

Symposium: Shortage of Scientists

FRIDAY, DECEMBER 30

9:30 a.m. Lecture Room 1, Atlanta Exhibition Hall

Socio-Economic Aspects of Orthopedic Engineering 1

Presiding: *Thomas P. Goodwin*

Assistive Devices for Severe Arm Paralysis, by *Robert L. Bennett,* M.D., Warm Springs Foundation

A Follow-Up Study of Warm Springs Polio Patients, by *Grace M. Freymann;* psychologist, George Warm Springs Foundation

Economic Outcomes of Vocational Rehabilitation of the Orthopedically Disabled, by *Donald Dabelstein,* Office of Vocational Rehabilitation, Department of Health, Education, and Welfare

1:30 p.m. Lecture Room L, Atlanta Exhibition Hall

Socio-Economic Aspects of Orthopedic Engineering 2

Presiding: *E. B. Whitten,* executive director, National Rehabilitation Association, Washington, D. C.

Economic Aspects of the Artificial-Limb Industry, by *McCarthy Hanger, Jr.,* president, J. E. Hanger, Inc., St. Louis, Mo.

Economic Aspects of the Orthopedic-Brace Industry, by *W. Frank Harmon,* Atlanta Brace Shop, Atlanta, Ga.

Engineering Applied to Orthopedic Bracing, by *Augustus Thorndike,* Chestnut Hill, Mass.; *Eugene F. Murphy,* Research and Development Division, Prosthetic and Sensory Aids Service, VA; and *Anthony Staros,* chief, Prosthetic Testing Development Laboratory, VA

Gaillard Industrial Standardization Seminar, January 23–27

AT the Gaillard Seminar on Industrial Standardization to be held January 23 through 27, 1956, in New York, N. Y., four out of the ten conferences will be devoted entirely to company standardization. Other major topics will be analysis of standardization and its application to engineering and management; forms of standardization, such as simplification, unification, and design of standards; and the art of writing specifications.

All subjects will be discussed around the table so that the conferees may bring up problems that have arisen in their own work. There will be two conferences each day, Monday through Friday, mornings 9:30 to 12:00, afternoons 1:30 to 4:00.

Leader of the seminar is John Gaillard, Mem. ASME, formerly a member of the staff of the American Standards Association, and a lecturer at Columbia University. He is now a management counsel specializing in advice on problems of standardization.

Further information may be obtained from Dr. John Gaillard, 400 West 118 St., New York 27, N. Y. Places at the seminar may be reserved in advance.

George Westinghouse, ASME President in 1910, engineer, inventor, scientist, and humanitarian, was elected to the Hall of Fame for Great Americans. He is credited with almost single-handed responsibility for adoption of the a-c system, which proved the key to the electrical era as we know it. The air brake and the friction draft gear made possible safe swift rail transportation. He first adapted the geared steam turbine to the job of driving ships.

The George Westinghouse bust, which has been on display at ASME headquarters, will be placed in the Hall of Fame for Great Americans. His associates conceded that Westinghouse defied classification; they compromised by naming him the "world's greatest living engineer." His inventive talent produced 361 patents. His business proficiency made possible the organization of 60 companies worth more than $200 million at the time of his death in 1914.

George Westinghouse, ASME President in 1910, Elected to Hall of Fame With Wright and General Jackson

Busts of Confederate General and Inventors to be placed in Hall of Fame, at NYU

GEORGE WESTINGHOUSE, President of The American Society of Mechanical Engineers, 1910, and inventor of the air brake and many major contributions to four vital industries—electrical, gas, rail, and marine; Wilbur Wright, co-inventor of the airplane; and Gen. Thomas Jonathan (Stonewall) Jackson, Confederate Army hero, were elected to the Hall of Fame for Great Americans at New York University, it was announced on November 1.

Dr. Ralph W. Sockman, director of the shrine and minister of Christ Church Methodist, New York, N. Y., announced that the new elections brought the total of distinguished Americans so honored to 86. Elections are held each five years and no more than seven can be added at each election.

The candidates must be Americans and must be dead at least 25 years. Busts of those elected are placed in the 55-year-old shrine of the University's Bronx, N. Y., campus overlooking the Hudson and Harlem River valleys and faces the New Jersey Palisades. The 630-ft-long colonade is one of the last examples of Stanford White's architecture.

Three Among 209 Elected

The three latest choices were the only candidates among 209 who received a majority of votes in the twelfth election. Their busts in bronze will be added to the 81 already installed. Two other busts, those of President Woodrow Wilson and Josiah Willard Gibbs, mathematical physicist, will be added soon. The last two were chosen in 1950.

The Westinghouse bust, shown elsewhere on this page, has been in the custody of The American Society of Mechanical Engineers since it was accepted by the Council from H. H. Westinghouse, the inventor's brother, with the hope that it one day would be placed in the Hall of Fame.

Mr. Wright received a total of 86 votes. His brother Orville, with whom he invented the airplane, was not eligible under the 25-year rule because he died in 1948. General Jackson was second with 72 votes. Mr. Westinghouse, who pioneered a number of railroad improvements, got 62 votes, one more than the majority required for election.

How They Are Elected

Nominations from the public were open for one year to April 1. Candidates were suggested from all parts of the country, and from special groups in high schools here, in Germany, Hawaii, Austria, Cuba, Puerto Rico, and the Panama Canal Zone.

In 1954 the shrine's College of Electors numbered 128 members. Of these, 121 cast ballots up to the October 15, 1955, deadline. Seven candidates received 20 or more votes, placing them automatically on the 1960 ballot. Included among these were: William James, philosopher and psychologist, 57; Henry David Thoreau, author and philosopher, 54; Edward A. MacDowell, composer and teacher of music, 53; Andrew Carnegie, industrialist and philanthropist, 49; Luther Burbank, naturalist, 42; Charles Eliot, former president of Harvard University, 20; and Winslow Homer, artist, 20.

Mr. Wright's name first appeared on the ballot in 1945. General Jackson's name has appeared in every election since the first one was held in 1900. Mr. Westinghouse was first proposed 15 years ago.

The Hall of Fame

The Hall of Fame was originated in 1900 by Dr. Henry Mitchell MacCracken, then chancellor of New York University. The shrine was financed through a gift of the late Mrs. Finley J. Shepard, the former Helen Gould. After the shrine was dedicated in 1901 the

first bust to be placed there was that of Horace Mann, educator. Theodore Roosevelt, in 1954, was the most recent addition.

While New York University holds the title to the Hall of Fame, Dr. Sockman has explained, it regards itself as a trustee under sacred obligations to administer the gift in such a manner as to conserve the patriotic and educational aims of the founder and donor. The gift was made to the American people, he has stated, and the University in administering it keeps in mind that the shrine is a national, not a local institution. No members of the faculty or staff of NYU are permitted to serve on the College of Electors.

People . . .

Honors and Awards. CHARLES ERWIN WILSON, secretary of defense, has been selected to receive the 1955 internationally recognized Washington Award for his "significant leadership in engineering and management and for his altruistic devotion to national defense."

This Award which was announced October 10 by the Washington Award Commission is sponsored by the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers and is administered by the Western Society of Engineers of Chicago. Since the Award was founded by John W. Alvord in 1916, an engineer has been selected each year whose contributions to society have gone far beyond the fields of engineering and science. The first recipient of the Award in 1919 was Herbert Hoover and in 1954 Lillian M. Gilbreth, Hon. Mem. ASME, was selected.

BENJAMIN F. FAIRLESS, chairman of the Executive Advisory Committee, U. S. Steel Corporation, has been selected as the 1955 recipient of the Award of Merit, presented annually by the American Institute of Consulting Engineers. Presentation of the award to Mr. Fairless took place on Tuesday evening, October 25, at the annual dinner for the engineering group at the Waldorf-Astoria Hotel, New York, N. Y.

ALFRED L. BOEGEHOLD, assistant to the vice-president in charge of General Motors Research Staff, was awarded the 1955 Gold Medal of the American Society for Metals "in recognition of his great versatility in applying science to the metal industry."

HARRY F. GUGGENHEIM, a leader in the development of aviation since World War I and in rocket and jet propulsion since 1929, has been elected to Honorary Membership in the American Rocket Society. The award was presented at the society's annual Honors Night dinner, on November 16, in Chicago, Ill., at the close of the ARS 25th Anniversary annual meeting.

LA MOTTE GROVER of Air Reduction Sales Company delivered the Adams Honor Lecture during the American Welding Society's national fall meeting in Philadelphia, Pa., October 17. Other awards at the Honors Session included the following: JOHN J. CHYLE, director of welding research, A. O. Smith Corporation, was presented the Samuel Wyle Miller Medal for contributing conspicuously to the advancement of welding. NIKOLAJS BREDZS, Armour Research Foundation, was awarded the Lincoln Gold Medal for the paper judged as the most original contribution to the advancement and use of welding and published in *The Welding Journal* during the 12-month period ending July, 1955. WILLIAM SPRAGAGEN, director of the Welding Research Council, was presented with an AWS Honorary Membership. Student awards went to MONROE EDWARDS, Georgia Institute of Technology, and WILLIAM J. GRESS, University of Florida, who received first and second prize, respectively.

RAYMOND L. BISPLINGHOFF, professor of aeronautical engineering, Massachusetts Institute of Technology, has been invited by the Institute of the Aeronautical Sciences to deliver the nineteenth Wright Brothers Lecture for 1955. Professor Bisplinghoff has chosen as his topic "Some Structural and Aeroelastic Considerations of High-Speed Flight." The lecture is scheduled for December 17, the fifty-second anniversary of the Wright Brothers' flight at Kitty Hawk, at 3:30 p.m., in the auditorium of the U.S. Chamber of Commerce Building, Washington, D. C.

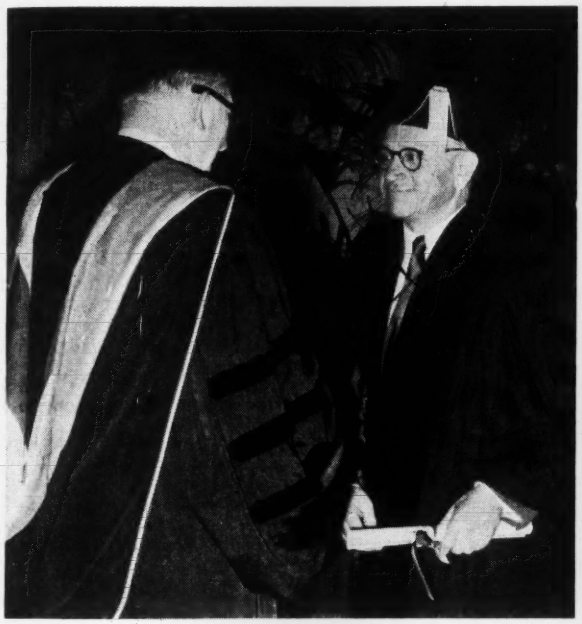
MAURICE HOLLAND, New York, N. Y., industrial research adviser to industry, foundations, and governments, was presented with a special Founder's Award by the Industrial Research Institute at a dinner, October 24, in the Shamrock Hotel, Houston, Texas, during its fall meeting.

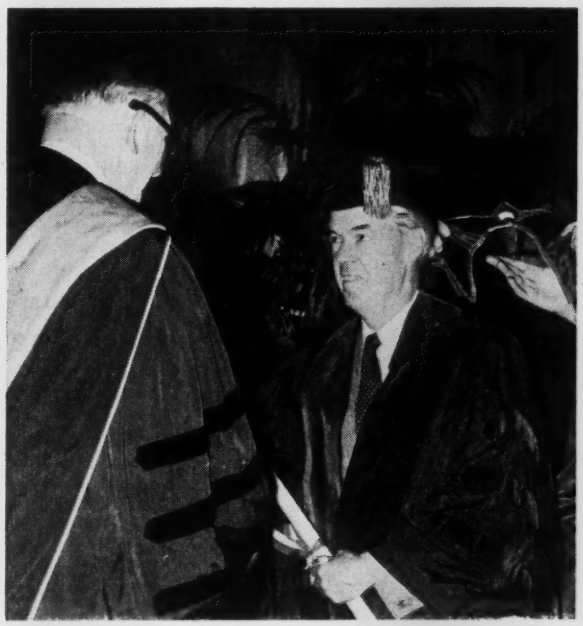
FRANK J. BINGLEY, color-television research engineer, Philco Corporation, has been named to receive the Vladimir K. Zworykin Television Prize Award for 1956 by the Institute of Radio Engineers. The Browder J. Thompson Memorial Prize for 1955 was awarded to JACK E. BRIDGES, research engineer, Zenith Radio Corporation, for his paper entitled, "Detection of Television Signals in Thermal Noise." The awards will be presented during the IRE convention to be held in New York, N. Y., March 19–22, 1956.

JOSEPH G. DAVIDSON, vice-president, Union Carbide and Carbon Corporation, New York, N. Y., received the Chemical Industry Medal for 1955 for "conspicuous services to applied chemistry." Presentation of the medal took place at a meeting of the American Section of the Society of Chemical Industry, sponsor of the medal, following a dinner in the medalist's honor in the Waldorf-Astoria Hotel, New York, N. Y.

NORMAN BROWN, associate professor of metallurgical engineering, received the University of Pennsylvania's 1955 Engineering Alumni Teaching Award as an outstanding junior member of the engineering faculties. The award was presented at the Engineering Alumni Society's annual dinner November 11, in the University Museum.

Unveiling of Marconi bust, October 11, at Engineering Societies Building, New York, N. Y., festive occasion. *Left to right:* Pietro Montana, the sculptor who presented the bust to American Institute of Electrical Engineers; Mrs. Gabriel Paresce of Washington, D. C., former Degna Marconi, who unveiled the bust; M. D. Hooven, AIEE president, who accepted the gift for the Institute; Guilio Marconi of Italy, son of the inventor; and Vittorio Ivella, secretary of the Italian Embassy and representative of the Italian Ambassador and the Italian Consul General in New York. Mr. Ivella praised the Institute for the fine work it was doing in many ways to maintain co-operative relations between the United States and Italy and especially for the Volta Scholarship which the Institute awards annually to a deserving young Italian engineer.





At the Polytechnic Institute of Brooklyn's closing convocation of its Centennial Year 17 scientific, educational, and community leaders received honorary degrees. Among those honored were: Philip Sporn, Hon. Mem. ASME, president of American Gas and Electric Association, shown in *left photo*, receiving an honorary DE degree from PIB President Harry S. Rogers, Mem. ASME. In *right photo*, Thomas E. Murray, Fellow ASME, commissioner, U. S. Atomic Energy Commission, Washington, D. C., receives DE degree from President Rogers.

At the dinner, the alumni joined in the University's observance of its centennial of engineering education. A "Centennial Symposium on Modern Engineering" was held earlier the same day.

WALTER L. FLEISHER, Mem. ASME, also was among those chosen by the faculties of the U. of P. Schools of Engineering to receive a citation awarded to graduates at the annual Engineering Alumni Society meeting. Mr. Fleisher is chairman of the advisory committee of engineers with the Air Pollution Control Board of New York, N. Y.

Campus News. CLARENCE E. BULLINGER, Mem. ASME, professor and head of the department of industrial engineering at The Pennsylvania State University, retired with emeritus rank, completing more than 33 years on the faculty. On October 1, Professor and Mrs. Bullinger departed for Formosa where he will begin a two-year assignment as educational adviser in industrial and mechanical engineering at Taiwan Engineering College in Tainan.

New Officers. The United Engineering Trustees, Inc., elected WALTER J. BARRETT as president for the ensuing year. Mr. Barrett is well known in engineering circles, being treasurer and a director of the American Institute of Electrical Engineers which he represents on the Board of UET. He is also a director of the New Jersey Bell Telephone Company, Newark. Other officers elected by UET include WILLIS F. THOMPSON, ASME, and A. B. KINZEL, vice-presidents; JOSEPH L. KOPP, treasurer; GEORGE W. BURPEE, assistant treasurer; and JOHN H. R. ARMS, secretary and general manager.

JAMES R. CRANWELL, vice-president of the Pennsylvania Railroad, New York, N. Y., has been elected president of the American Standards Association. Mr. Cranwell fills the post left vacant by the death of EDWARD T. GUSHEE, vice-president of the Detroit Edison Company.

Lee De Forest, *center*, receives the first Achievement Award presented during the tenth annual Instrument-Automation Conference and Exhibit of the Instrument Society of America at Los Angeles, September 14. A. O. Beckman, *right*, presented the award. Warren H. Brand, retiring ISA president, is at left.

Major Manoel F. Behar, Mem. ASME, receives Honorary Membership Award of the Instrument Society of America from ISA President Warren H. Brand, during the Society's tenth annual Instrument-Automation Conference and Exhibit in Los Angeles, Calif., Sept. 14–16, 1955

Mr. Cranwell became a member of the Board of Directors of ASA in 1953, representing the Association of American Railroads.

ROBERT T. SHEEN, president, Milton Roy Co., Philadelphia, Pa., was elected president of the Instrument Society of America at its tenth annual Instrument-Automation Conference and Exhibit held in Los Angeles, Calif., September 12–16. Two vice-presidents and secretary elected were: RICHARD N. POND of Taylor Instrument Companies, Rochester, N. Y., as vice-president in charge of the society's Technical Division Committees; J. WARD PERCY of U. S. Steel Corporation, Kearney, N. J., vice-president in charge of Recommended Practices Division consisting of 23 subcommittees; and WILLIAM G. BROMBACHER, Mem. ASME, of Chevy Chase, Md., secretary.

ARTHUR V. LOUGHREN, color-television expert and vice-president in charge of research of the Hazeltine Corporation, was elected president of the Institute of Radio Engineers for 1956. Other officers elected included: HERRE RINIA, director of research, Philips Research Laboratories, Eindhoven, Holland, vice-president; and directors for the 1956–1958 term, E. W. HEROLD, director, Electronic Research Laboratory, RCA Laboratories, Princeton, N. J., and J. R. WHINNERY, professor of electrical engineering, University of California, Berkeley, Calif.

HEINRICH GRUNEWALD was recently named director of the Verein Deutscher Ingenieure, Dusseldorf, Germany. He was inaugurated as director upon the resignation of ERICH KOTHE, who had served in that post for several years.

ASME Membership as of Oct. 31, 1955

Honorary Members	73
Fellows	410
Members	14,627
Affiliates	301
Associate Members (33 and over)	3,817
Associate Members (30–32)	4,493
Associate Members (to the age of 29)	17,030
Total	40,751

Meetings of Other Societies

Dec. 17
IAS, Wright Brothers Lecture, Auditorium, Chamber of Commerce Building, Washington, D. C.

Dec. 26–31
AAAS, Biltmore Hotel, Atlanta, Ga.

Dec. 29–30
ACS, Division of Industrial and Engineering Chemistry, symposium, Princeton University, Princeton, N. J.

(ASME Calendar of Coming Events, see page 1148)

L. L. Strauss All-Congress Dinner Speaker, Nuclear Engineering Congress, Cleveland

Senator Anderson of New Mexico joins prominent leaders to address Congress

ADMIRAL LEWIS L. STRAUSS, chairman of the United States Atomic Energy Commission, heads the list of speakers at the All-Congress Dinner of the Nuclear Engineering and Science Congress to be held in Cleveland, Ohio, Wednesday, December 16, at the Hotel Statler.

The Congress is sponsored by 26 engineering and scientific societies, of which ASME is one, and is co-ordinated by Engineers Joint Council. The Congress begins Monday, December 12, and continues through Friday, December 16. The Atomic Exposition, displaying the latest devices and materials for industry in the application of nuclear energy with nearly 150 exhibitors, runs concurrently with the Congress in the Exhibition Hall of Cleveland's Public Auditorium. The exposition will open on Saturday, December 10.

Admiral Strauss will deliver the keynote address of the Congress. With more than 300 technical papers devoted to various aspects of the progress being made toward the peaceful uses of the atom, 2000 engineers and scientists are expected to attend the Congress.

One of the high points of the week-long gathering, the all-Congress dinner, will be attended by business, industrial, and political leaders, in addition to engineers and scientists specializing in the nuclear fields.

Thorndike Saville, president of Engineers Joint Council and dean of the College of Engineering, New York University, will make the welcoming address. Walker L. Cisler, Fellow ASME, president, Detroit Edison Company, and president, Atomic Industrial Forum, Inc., will be toastmaster. Dr. John R. Dunning, Mem. ASME, dean of the Columbia University School of Engineering, will introduce Admiral Strauss.

Senator Clinton P. Anderson of New Mexico, chairman of the U. S. Senate Committee on Atomic Energy, and Keith Glennan, president of Case Institute of Technology and former member of the AEC, will be speakers at another dinner which will be held in connection with a management conference also sponsored by EJC. This dinner is designed to interest people in the commercial aspects of atomic energy.

ASME Florida Section honors two members. A. C. Weigel, *left*, receives an award from the Boiler Code Committee and W. R. Pender, *center*, a Life Membership in the Society. The presentations were made by B. D. Kitching, *right*, chairman of the Section.

AIME-ASME Joint Fuels Conference Draws Large Audience

One hundred and ninety attended the 18th annual Joint Solid Fuels Conference of the Coal Division, AIME, and the Fuels Division, ASME, at the Neil House, Columbus, Ohio, October 19–20, 1955. The meeting was in reality a two-day session with a late recess for sleep the first night. It was the same identical, attentive, specially interested group of solid-fuel engineers and technologists that arrived early Wednesday morning, stuck together through the four technical sessions, two coffee breaks, two luncheons, a cocktail party, and a banquet. A smaller group remained until Friday, October 21, for visits to Battelle Memorial Institute, Bituminous Coal Research, Inc., and several local plants.

Conference Features

Two innovations and a distinction were featured at this conference. There was an authors' and presiding officers' breakfast each morning—businesslike affairs, at which authors and chairmen got acquainted, and arrangements and timing for the technical sessions were pointed up. A bit of ritual was J. M. Clark's presentation of the gavels to chairmen for the day. The coffee break immediately following the first paper at the morning sessions was the second conference innovation. Any apprehension that the audience would get lost was needless. The coffee was hastily downed and all hands filed back promptly. The coffee, plus fresh air, had a bracing effect that carried through to luncheon. The distinction of this conference was that the registrants' envelopes contained something to represent every paper on the program, either the paper in its complete form or a sizable abstract.

Social Events

At the initial luncheon on Wednesday, David R. Mitchell, division secretary, told the combined AIME-ASME group what the AIME Coal Division is and what it does, and Carroll F. Hardy, chairman, Fuels Division ASME, in turn, took an oral, informative "look" at his Division.

A pleasurable feature of the banquet Wednesday evening, was the song fest by the Ohio State University Men's Glee Club. L. C. Campbell, president, National Coal Association, was the speaker—his subject, "Coal—Our National Heritage." Here are a few enlightening statistical facts from his address: "Coal supplies 65.6 per cent of the fuel used in generating the nation's electricity, exclusive of water power. . . . Coal heats one third of the houses of America; supplies the essential raw materials for nearly a third of the entire United States organic chemical industry. . . . The industry will need increasing numbers of engineers in almost all phases of its work in the years immediately ahead. . . . The industry has established 99 scholarships. . . . available in nine states, to help deserving coal-mining engineer candidates."

Prof. W. A. Mueller, Ohio State University, represented AIME President H. DeWitt Smith at the banquet head table; Thompson Chandler, Vice-President, ASME Region V, represented ASME President David W. R. Morgan.

Percy Nicholls Luncheon

At the Percy Nicholls luncheon meeting Thursday, E. R. Price, chairman of the Award Committee, introduced Elmer R. Kaiser, Mem. ASME, who in turn presented the Percy Nicholls Award for 1955 to Ralph M. Hardgrove, Fellow ASME. Mr. Kaiser held up the engrossed certificate, a beautiful thing, for all to see.

The Award is given for notable scientific or industrial achievement in the field of solid fuels and whereas the citation is too long for presentation here, the last paragraph indicates the whole: "In him we recognize an internationally known Engineer, Research Consultant, Author, and Inventor whose important work in the field of solid fuels has contributed materially to the advancement of steam-generating plants." Ralph A. Sherman, Fellow ASME, discoursing on "A Man and His Work," told the members much about Percy Nicholls, his life, personality, and work. Mr. Sherman exhibited a large photograph of Nicholls in his laboratory.

For the technical papers one must look to the respective media of the two Divisions. There were seven of AIME origin and five ASME. The discussion was earnest and extensive.

Two papers which were referred to as "long hair," were washed out of the hair of so many speakers from the floor that the discussion period had to be extended. The papers are listed, by sessions, in the program published on page 840 of the September issue of Mechanical Engineering.

Conference Committees

This Joint Solid Fuels Conference, generally acclaimed as highly successful, was engineered by a committee so alert on the job that they richly deserve individual mention, and are as follows:

Elmer R. Kaiser, general chairman (AIME), William T. Reid, co-chairman (ASME), J. H. Melvin, treasurer; Finance, John F. Fulford; Hotel, M. L. Smith, E. B. Lund, and Paul Bucher; Registration, C. J. Lyons, S. D. Heil, and J. D. Hummell; Publicity, A. B. Clymer; Technical Details, W. C. Holton; Printing and Signs, G. E. Haney, W. L. Hartman, and J. R. Lucas; Entertainment, J. M. Pilcher, J. F. Cunningham, Jr., and J. A. Eibling; Plant Trips, J. R. Garvey, R. J. Anderson, and P. O. Kock.

The program chairman for AIME, T. R. Jolley; ASME, C. H. Marks.

H. F. Yancey is the chairman of the Coal Division, AIME, and Carroll F. Hardy is chairman of the Fuels Division, ASME.

The chairman of the Ladies' Activities Committee was Mrs. Hazel G. Reid. Twenty-seven women attended the Conference.

1956 Conference Announced

The 19th Annual Joint Solid Fuels Conference will be held next year at the Sheraton-Park Hotel, Washington, D. C., on either Wednesday and Thursday or Thursday and Friday in the week of October 22. The co-chairmen of the General Committee for the Conference are L. R. Caplan, ASME, and L. C. McCabe, AIME.

In left photo Ralph M. Hargrove, Mem. ASME, *left,* receives the 1955 Percy Nicholls Award at a special luncheon held during the ASME-AIME Joint Solid Fuels Conference from Elmer R. Kaiser, Mem. ASME, co-chairman of conference. In right photo L. C. Campbell, president, National Coal Association, addresses the banquet audience attending the ASME-AIME Joint Solid Fuels Conference at Neil House, Columbus, Ohio, Oct. 19–21, 1955.

ASLE-ASME Second Lubrication Conference In Indiana Wins Approval

A THREE-DAY conference was held jointly by the American Society of Lubrication Engineers and the Lubrication Division of The American Society of Mechanical Engineers at the Antlers Hotel, Indianapolis, Ind., Oct. 10–12, 1955. This was the second annual conference, the first of which was held in Baltimore, Md., October of last year.

More than 300 people attended this conference at which 26 papers were presented. The technical papers were presented at six sessions and were enthusiastically received by the large audience in attendance. The papers covered both research and the latest developments in the field of lubrication.

The papers, presented in sessions, dealt with such important topics as instability in journal bearings, two conferences on recent studies in hydrodynamic lubrication, lubricants, roller-element bearings, and boundary lubrication.

As was the case at the first conference, all the registrants were given one copy each of all the papers presented. Aside from saving the cost of papers to the registrant, the inconvenience of procuring papers during the conference or sometime afterwards was eliminated.

It was evident that the conference, not only presented recent developments and latest techniques, but provided a central meeting place for all engineers interested in the field of lubrication. The conference won the professional approval of the engineers attending the meeting. Plans are now in progress for next years' conference, which because of the success of the first two, should prove to be an attraction to an even greater number of people interested in the study of lubrication.

S. Abramovitz opens the Second Annual ASLE-ASME Lubrication Conference in Indianapolis, Ind.

Availability List for 1955 Joint ASME-ASLE Lubrication Conference

THE papers in this list are available in separate copy form until August 1, 1956. Please order only by paper *number;* otherwise the order will be returned. Copies may be purchased from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.; 25 cents per copy to ASME members; 50 cents to nonmembers.

Paper No.	*Title and Author*
55—LUB-1	Analysis of Partial Journal Bearings Under Steady Loads, by J. C. LEE
55—LUB-2	Difluorodichloromethane as a Boundary Lubricant for Steel and Other Metals, by S. F. MURRAY, R. L. JOHNSON, and M. A. SWIKERT
55—LUB-3	The Lubrication of Friction Drives, by T. B. LANE
55—LUB-4	Thermal Aspects of Galling of Dry Metallic Surfaces in Sliding Contact, by F. F. LING and E. SAIBEL
55—LUB-5	Physico-Chemical Investigation of Engine-Oil Performance, by A. BONDI, S. J. BEAUBIEN, and H. DIAMOND
55—LUB-6	The Rheostatic Thrust Bearing, by F. OSTERLE and E. SAIBEL
55—LUB-7	Density - Temperature - Pressure Relations for Liquid Lubricants, by H. A. HARTUNG
55—LUB-9	Predicting Performance of Starved Bearings, by D. F. WILCOCK
55—LUB-10	Operating Characteristics of High-Speed Bearings at High Oil-Flow Rates, by C. C. MOORE and F. C. JONES
55—LUB-11	Temperature Effects in Hydrostatic Thrust-Bearing Lubrication, by W. F. HUGHES and J. F. OSTERLE
55—LUB-12	Varieties of Shaft Disturbances Due to Fluid Films in Journal Bearings, by B. L. NEWKIRK
55—LUB-13	Studies in Lubrication XI: Slider Bearing With Transverse Curvature; Exact Solution, by A. S. C. YING, A. CHARNES, and E. SAIBEL
55—LUB-14	Finite Journal Bearings With Arbitrary Position of Source, by J. V. FEDOR
55—LUB-15	Journal-Bearing Performance for Combinations of Steady, Fundamental, and Low-Amplitude Harmonic Components of Load, by G. S. A. SHAWKI
55—LUB-16	Analytical Study of Journal-Bearing Performance Under Variable Loads, by G. S. A. SHAWKI
55—LUB-17	High-Temperature Bearing Operation in the Absence of Liquid Lubricants, by S. S. SOREM and A. G. CATTANEO
55—LUB-18	Prediction of the Viscosity of Liquid Lubricants Under Pressure, by H. A. HARTUNG
55—LUB-19	The Effects of Pressure and Temperature on the Viscosity of Lubricants, Part 2, Application of Vogel's Equation, by R. B. Dow
55—LUB-20	Experimental Verification of Theoretical Investigations Into Half-Frequency Whirl, by B. STERNLICHT
55—LUB-21	Effect of Combustion-Resistant Hydraulic Fluids on Ball-Bearing Fatigue Life, by H. V. CORDIANO, E. P. COCHRAN, JR. and R. J. WOLFE.

ECPD Names Officers and Committee Chairmen

THORNDIKE SAVILLE, dean, College of Engineering, New York University, was elected president at the 23rd Annual Meeting of Engineers' Council for Professional Development held in Toronto, Ont., Can., Oct 13 and 14, 1955. Russell G. Warner, vice-president, The United Illuminating Company, New Haven, Conn., and W. H. Wisely, executive secretary, ASCE, were elected vice-president and secretary, respectively. S. L. Tyler was elected executive secretary and E. O. Kirkendall (secretary, American Institute of Mining and Metallurgical Engineers) was elected assistant secretary.

The Executive Committee will consist of the officers (ex officiis) and one representative of each of the participating societies, as follows: H. S. Rogers (ASCE), E. Paul Lange (AIME), H. N. Meixner (ASME), W. Scott Hill (AIEE), W. Stewart Wilson (EIC), Warren L. McCabe (AIChE), L. E. Grinter (ASEE), and James H. Sams (NCSBEE).

Chairmen of standing and special committees were named as follows: Guidance Committee, K. F. Treschow; Education and Accreditation, Harold L. Hazen; Student Development, N. W. Dougherty; Training, Edwin L. Yates; Recognition, George H. O'Sullivan; Ethics, C. J. Freund; and Information, Walter E. Jessup.

Representatives of The American Society of Mechanical Engineers are: A. C. Monteith (1956), and H. N. Meixner (1957), and one member to be appointed.

Tau Beta Pi Holds Fiftieth Convention

TAU BETA PI's fiftieth national convention was held at Michigan State University, East Lansing, Mich., Oct. 2–5, 1955. The Michigan Alpha chapter at Michigan State Uni-

versity was official host, and all but one of the Association's 96 collegiate chapters were represented at the session. The Convention was also attended by Tau Beta Pi's national officers headed by President Harold M. King, Mem. ASME, retired turbine engineer for the General Electric Company at Lynn, Mass.

The Convention, headquartered at Michigan State's Kellogg Center for Continuing Education, consisted of five business meetings, several specially arranged discussion periods, and two after-dinner programs which were of particular interest.

Charters for three new chapters of the Association were granted by the Convention in response to petitions received from local engineering honor societies at the University of Santa Clara at Santa Clara, Calif., Howard University in Washington, D. C., and the University of Massachusetts at Amherst, Mass. Faculty and student representatives of those three schools attended the Convention and presented their groups' requests at the national meeting. The three new chapters will be installed early in 1956. They will increase the number of Tau Beta Pi undergraduate chapters to 99, located at prominent accredited engineering schools all over the United States.

Following a pattern of long standing, a proposal to admit women to membership in Tau Beta Pi was again offered at the 1955 Convention. But the national meeting rejected the proposal once more, leaving Tau Beta Pi exclusively a male organization. However, the Association's chapters will still be empowered to award special Women's Badges to girls who meet the same scholarship and character qualifications required of men for membership. Over the past 21 years, 187 women have been so honored.

The Convention voted to hold the 1956 national meeting at the University of Kansas, Lawrence, Kan., in October. The Kansas Alpha chapter of Tau Beta Pi will serve as host to that 51st Convention.

Government and Industry Confer on National Standards

THIS is a report on the events of the sixth national Conference on Standards, held October 24–26 at the nation's capitol. The conference on "Government-Industry Co-Operation in Standardization" was sponsored by the American Standards Association and the National Bureau of Standards. More than 800 representatives of government, industry, and the military attended.

Standardization Cuts U. S. Arms Cost

Thomas P. Pike, Assistant Secretary of Defense, Supply, and Logistics, implored American industry to develop a comprehensive set of national standards. This can only be done, he said, in the keynote address of the conference, by close co-operation of government and industry in standards work.

He pointed out that increased standardization in producing weapons and their military hardware would save taxpayers "mountains of money," and added that more industrial standardization is a vital defense need. Without it, he said, the national safety will be jeopardized.

Mr. Pike also warned that the United States is rapidly becoming a "have-not nation" in a number of raw materials, which we cannot go on wasting for want of national standards.

As growing evidence of government-industry co-operation, A. V. Astin, director of the National Bureau of Standards, cited NBS participation in the work of 250 committees of the American Standards Association. Dr. Astin opened the conference with a welcoming address.

The Fifteen-Hundredth Standard

The Fifteen-Hundredth American Standard has just been approved, it was disclosed by Vice-Admiral George F. Hussey, Jr., U.S.N. (ret.), managing director of the American Standards Association. This is double the number of American Standards in national use in 1948 and many of those have been revised, some several times, he said.

The standard was submitted to the ASA by the American Society for Testing Materials. It is the American Standard Specifications for Nickel-Chromium-Iron Alloy Seamless Pipe and Tubing, H34.3-1955-ASTM. Chairman of the ASTM committee which developed the standard is E. R. Patton, Mem. ASME, International Nickel Company, New York, N. Y.

Government-Industry Harmony

Lowell Mason, Federal Trade Commissioner, opening the Monday evening, October 24, session, emphasized the importance of the conference as "a symptom of the changing trend in government-industry relations in the field of national standards." It recognizes that people are entitled to know where we stand, he stated.

Ephraim Jacobs, chief of the legislation and clearance section, Justice Department Antitrust Division, agreed that standardization has been an important factor in industrial progress. The Justice Department is not against legitimate standardization, he assured the conference. He warned, on the other hand, against the misuse of standards for illegal price fixing or to limit competition.

Substituting Plane Parts Unsafe

There is inadequate protection in airplanes against substitution of unproved parts, according to C. E. Mines, Mem. ASME, chief of engineering services, Allison Division of General Motors and chairman, Aeronautics Committee, Society of Automotive Engineers. At the afternoon session on defense standards he said, "Distinctive part numbering and distinctive marking of aeronautical standard items are musts.

"The product designers' know-how should be recognized as vital on changed parts just as it is now recognized on brand-new parts. A clear understanding is needed that it is legal to include in a series of standards a recognition and definition of a proprietary device which has been proven trustworthy."

Thomas P. Pike, *left*, Assistant Secretary of Defense, Supply, and Logistics, was keynote speaker at the opening session of the sixth national Conference on Standards. With Mr. Pike, *left to right*, are A. V. Astin, director, National Bureau of Standards; A. S. Johnson, vice-president, American Mutual Liability Insurance Company and chairman of ASA Standards Council; and Vice-Admiral G. F. Hussey, Jr., U.S.N. (ret.), managing director of the American Standards Association. The conference was held at the Sheraton-Park Hotel, Washington, D. C., October 24–26, and was jointly sponsored by NBS and ASA. The conference theme was Government-Industry Relations in the Field of Standards.

15 Per Cent Savings to Government Through Standardization

Standardization of commodity requirements by the General Services Administration has saved the government 15 per cent of its previous costs in the fields standardized, Edmund F. Mansure, administrator, reported. He said the GSA has completed 58 projects on commodity standardization. These eliminated 85 per cent of the items involved. "Instead of regularly handling 2230 different items of such things as furniture, we now handle only 330," Mr. Mansure pointed out.

He assured the conference that GSA will continue its standards program. "We look upon our standards program as a three-point weapon in the fight for economy," he said. "Specifications, commodity standards, and cataloging are the best administrative tools at our command to bring order and intelligence into the enormous pool of items we buy."

World War II Shortages Due to Lack of Standards

Critical shortages of equipment during World War II were not true shortages, Col. Joseph R. DeLuca, USAF, staff director for cataloging, Department of Defense, told the conference.

"With our pipe lines filled with tons of supplies, we still had shortages," he said. "Actually, these items were in our own pipe lines without our knowledge because of lack of identification, malidentification, or different identifications for the same item between departments. Thus we created waste, inefficiency, and sharp risk of equipment failures.

Further, we had a minimum of support capabilities between our pipe lines for effective supply support to combat operations."

Government Participation Asked

Full participation of government in ASA work was asked by Standards Council Chairman Arthur S. Johnson at the morning session, October 24. He asked government departments to follow the Defense Department's lead in removing all restrictions on government representatives serving on committees of the American Standards Association.

Inter-American Standards Program

Lewis Ortega, Division of Economic Research, Organization of American States, told the conference that the implementation of a standards program for the 21 American republics would have tremendous significance to the more than 300 million people of these countries.

"Trade figures show that Latin America depends to a large extent on United States goods and services, and absorbs a large proportion of United States exports. In 1954, Latin American purchases from the United States mounted to 3 billion, 371 million dollars, which is equivalent to one fourth of the total United States exports," he said.

Engineering Foundation Grants Advance Varied Projects

ENGINEERING Foundation, which administers the income from a $1 million fund dedicated to the stimulation of engineering research, has now made available its allocations for the 1955–1956 fiscal year. Although this income of about $50,000 seems very modest in comparison with the present-day scale of research expenditures, it has served to nurture in their early stages many research programs which have ultimately attracted large-scale financial support from other sources and become projects of major import.

This year's grants total $61,850. They will advance 26 projects, which are receiving estimated outside support of $426,000. The projects, which cover a wide range of research, are being carried out in university laboratories all over the country under sponsorship of the major engineering societies.

Properties of Steam

An important project receiving one of the grants is a study of the Properties of Steam, which is being sponsored by The American Society of Mechanical Engineers. The Steam Properties Research Program, which was established at the Fourth International Steam Tables Conference in Philadelphia, Pa., in September, 1954, revives an earlier ASME program that was completed in 1934. The extremely high pressures and temperatures commonly used today in both steam-power generation and chemical processing emphasize the need for extending the present working steam tables that have been in use since 1934. As a first step, the research program will try to obtain experimental data for extending the steam-table range to 1500 F and 15,000 psia. It will function within an international framework.

ASME-ASTM Project

Of much significance also is a joint program of The American Society of Mechanical Engineers and the American Society for Testing Materials on the Effect of Temperature on the Properties of Metals. In the 31 years of its existence this joint project has done a tremendous job in devising reliable methods of testing metals at high and low temperatures and in determining the effect of these temperatures on the strength properties of a wide variety of metallic materials, especially steel.

High-Temperature Steam Generation

The decline in the cost of electric power in the past decade of steadily rising prices is due in large part to studies by turbine and steam-generator manufacturers and power-generating companies, which have made it possible for central-station generating plants to improve their efficiency by the use of increasingly higher steam temperatures and pressures. Receiving the support of these groups as well as of Engineering Foundation is an ASME-supported program on High-Temperature Steam Generation. This ASME project—begun in 1932, dropped during the war, and re-established in 1949—is attempting to lower electric-power costs still further by studying the possibility of using a regenerative steam cycle at temperatures up to 1650 F. Of particular concern to this group are the severe corrosive action of high-temperature steam and the lack of metallurgical stability of the materials available for superheater tubing. New tests will be made at the Philip Sporn Plant of the American Gas and Electric Company, where steam is available at 1000 F temperature and 2000-psi pressure. For these tests special apparatus has been designed in co-operation with the U. S. Navy Bureau of Ships.

Reinforced-Concrete Research

A reduction in the cost of reinforced-concrete construction and the use of longer concrete spans than are now permissible may be ultimate benefits of another project, the Reinforced Concrete Research Council, which was established in 1948 under sponsorship of the American Society of Civil Engineers. This project began with a critical re-examination of the empirical basis for the design of reinforced-concrete structures, which has been in use for many years, with the idea of developing a workable scientific theory for such design to replace the old empirical methods. The research, involving extensive testing of reinforced-concrete members under a wide variety of conditions of load, stress, and exposure, is currently under way at the University of Illinois, Virginia Polytechnic Institute, Lehigh University, and Syracuse University.

Wave Research

The Council on Wave Research, an independent research program set up to survey the various phases of water-wave action in order to determine the fields in which information is lacking, continues to receive Engineering Foundation support. In the past five years the Council has brought together workers in the field of wave research and related activities in five conferences on Coastal Engineering and one conference on Ships and Waves. On October 31 and November 1 and 2 of this year it sponsored a Conference on Coastal Engineering Instruments at its headquarters at the University of California, Berkeley. The conference was devoted to summarizing the various types of oceanographic instruments of value to engineers.

Thermal Resistivity of Soils

A three-year research project on the Thermal Resistivity of Soils—cosponsored by the American Institute of Electrical Engineers, Engineering Foundation, and various other groups—is beginning at Princeton University, Princeton, N. J. This project was authorized to study the heat-dissipation characteristics of various soil types, because of the importance of

such information in determining the load-carrying capacity of underground-cable systems and in many other fields of engineering. It will cover such factors as effect of soil solids content, critical heat rate, critical temperature gradients, moisture migration effects, and re-wetting characteristics of clays.

AIME Projects

Grants are also being made to eight projects under sponsorship of the American Institute of Mining and Metallurgical Engineers. These AIME projects include a newly instituted program for predicting disastrous storm surges, which is getting under way at Columbia University's Lamont Laboratories at Palisades, N. Y.

Syracuse University Dedicates New Engineering Building

A NEW modernly equipped $940,000 engineering building, William Lawyer Hinds Hall, was dedicated by Syracuse University on its main campus, October 7.

Hinds Hall is the first building to be completed in a two-unit $1,500,000 engineering plant started by the University, October, 1953. The other building, partly finished, now consists of a basement and subbasement. Four more stories will be added.

In naming the building, Syracuse University honors William Lawyer Hinds, past-chairman of the board of Crouse Hinds Co., Syracuse, for the many years of service he has rendered to engineering education and the numerous contributions he has made for the expansion of engineering facilities at Syracuse University.

At the dedication ceremonies honorary LLD degrees were awarded to Marion B. Folsom, secretary of the U. S. Department of Health, Education and Welfare; Irving S. Olds, member of the White and Case law firm, New York, and former chairman of the board of the U. S. Steel Corporation; Alfred P. Sloan, Jr., chairman of the board, General Motors Corporation; Willis H. Booth, prominent banker and honorary president of the International Chamber of Congress; Albert B. Merrill, president of the First Trust and Deposit Co., Syracuse, and chairman of Syracuse University's Board of Trustees.

DS degrees were given to Dr. Frederick E. Terman, provost and dean of the School of Engineering, Stanford University; and Malcolm P. Ferguson, president of the Bendix Aviation Corporation.

The first building to go up on the eastern half of the main campus designated as the natural science and engineering quadrangle, Hinds Hall offers new, improved instructional and research facilities to the electrical, civil, industrial, chemical, and mechanical-engineering departments.

Primarily a laboratory-type building, Hinds Hall contains 120 rooms—offices, laboratories, seminar, and demonstration rooms. There are no conventional-type classrooms in the building.

Contemporary in design, featuring brick facing with limestone trim, Hinds Hall contains $1,750,000 worth of engineering equipment.

By far the most expensive and intricate piece of equipment in the building is the $430,000 network analyzer located in special studiolike quarters on the first floor.

This analyzer, which solves power-transmission and electrical-distribution problems, was formally presented to the University, October 8, by the Niagara Mohawk and Power Corporation and the New York State Electric and Gas Corporation with the co-operation of the General Electric Company.

In addition to being used by utility companies for research purposes, the analyzer provides invaluable, practical experience to graduate students interested in the power-systems field.

Massachusetts University Dedication of Engineering Building Occasion for Education Appraisal

MAYNARD M. BORING, Mem. ASME, consultant for engineering manpower to the General Electric Company, called for an increase in the efficiency of the country's engineering educational system October 29, 1955. He spoke at dedication exercises for the new $1,350,000 engineering building at the University of Massachusetts, in Amherst.

Pointing out that only one half of engineering freshmen go on to graduate from college, and that only one half of the nongraduates fail through scholastic difficulties, Boring said, "Many of the failures are due to loss of interest, financial, and other reasons that might well be controlled. Much can be done with the nonfailures and we may well find some highly qualified individuals in this latter group."

The G-E consultant, who is also president of the American Society for Engineering Education, said that President Eisenhower's road-building plans alone would demand an additional 22,000 civil engineers in the next 10 years.

"The advent of automation requires additional large numbers," he said. "Change-overs developing from the use of atomic energy and other technological developments requiring greatly increased numbers of engineers and scientists clearly indicate that we must do all we can to continue expanding our scientific and technological colleges," he continued.

New Engineering Laboratory

The new engineering laboratory at the state university is completely modern in design and equipment, adding 38,000 sq ft of floor area to an electrical-engineering wing which was completed in 1949.

The new building houses laboratories for civil engineering, in soil mechanics, sanitary engineering, applied mechanics, and structural engineering.

Industrial engineering will have a laboratory and equipment for time and motion studies, as well as work simplification.

The metallurgical facilities are now increased by a metal process laboratory and x-ray and nondestructive testing equipment.

Mechanical engineering will have a new laboratory for vibration studies in the field of dynamics.

Engineering Library

Space is also provided for an engineering library seating 40 students. Seven new classrooms, two new drafting rooms, staff-office space, and a university radio studio are also included. The radio facilities will be used both by engineering students for technical studies and by the department of speech for instruction in radio and television courses. It will also house the campus FM educational broadcasting unit, WMUA, whose transmitter will be relocated from South College.

The School of Engineering was established at the University of Massachusetts in 1947.

NYU Gets a Pint-Size Atom Plant

NEW YORK UNIVERSITY will soon be the first college in the New York metropolitan area to produce a limited nuclear-fission chain reaction.

A subcritical reactor—a nuclear-energy device that can produce but not sustain a fission chain reaction—will be installed in the College of Engineering as soon as the University signs a contract with the Atomic Energy Commission for the loan of uranium ore and scientific equipment.

This was assured Nov. 3, 1955, when Lewis L. Strauss, chairman of the Commission, announced that it had approved a loan of two tons of uranium-bearing ore and a neutron source to the University.

The reactor, the Commission said, "Requires no controls and will be safe at all times." It requires neither expensive sheathing nor heat-removal apparatus and may be used for many laboratory exercises in nuclear engineering. It will be the first of its kind in any university.

The reactor will consist of a five-ft tank of water, called a "pickle barrel," in which uranium rods will be suspended. The neutron source will be placed within the rods to cause a neutron flux.

Chain reaction will be restricted because ordinary water and not heavy water will be used in the tank; also, the metal of the rods will be a relatively stable, unenriched uranium. In comparing the instrument to the total reactor, Dr. Lyle B. Borst, chairman of the department of physics, said the product of the subcritical reactor was like the "small bulb on a Christmas tree would be to a large searchlight."

The commission's action represents the first grant under its policy of assistance to nonprofit educational institutions interested in working with subcritical reactors. It is hoped that such a program will help alleviate the shortage of nuclear scientists.

ASME Elects Seventeen Fellows . . .

THE AMERICAN SOCIETY of Mechanical Engineers has honored 17 of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer with acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men, whose outstanding contributions to their profession and to the Society, who were so honored are:

Ernst William Allardt

ERNST W. ALLARDT, chief engineer, Tubular Products Division, The Babcock & Wilcox Company, Alliance, Ohio, has specialized in cold-roll metal-forming and electric-weld tube and pipe mills. From 1922 to 1942 he was employed by The Yoder Company, Cleveland, Ohio, first as chief draftsman and then as chief engineer. During this period he was responsible for the design of several welded-tube mills 1 in. to 4 in. in capacity. He also designed a 26-in-diam pipe electric-resistance weld mill and accessory equipment at Youngstown Sheet and Tube Company. From 1936 to 1942 he designed many ERW tube mills and special sheet and strip metalworking machines. In 1942 he joined Babcock & Wilcox as chief engineer, Tubular Products Division, and has since designed several plants in the United States and Europe along with mills and accessory equipment. Since joining the Society in 1926 Mr. Allardt has served ASME on the Executive Committee, Akron-Canton Section, 1946–1948, and as chairman of the Akron-Canton Section, 1948–1949; chairman of the Canton-Alliance-Massillon Section, which Section he helped to organize, 1950; and as chairman of the National Nominating Committee, 1954–1955; and many others. In 1951 he received the ASME Achievement Award. In 1955 he was awarded the ASME 75th Anniversary Medal; also in that year the ASME Certificate of Merit. Mr. Allardt has contributed extensively to the literature on operating electric-weld tube mills, including manuals, articles, and was the 1942 award winner of the James F. Lincoln Arc Welding Foundation. He holds several American and British patents.

Edgar Alfred Allcut

EDGAR A. ALLCUT, head, department of mechanical engineering, University of Toronto, Ontario, Can., is known for his work in the fields of heat transfer and producer gas. In addition to his present position he is responsible for the course in engineering and business at the University. Professor Allcut joined the school's faculty of applied science and engineering in 1921. He became a professor in 1931 and head of the mechanical-engineering department in 1944. Professor Allcut is the author of many technical papers and of several books. His books include: "Materials and Their Applications to Engineering Design," 1923; "Principles of Industrial Management," 1950, fifth edition; "Engineering Inspection"; "Introduction to Heat Engines," 1945, second edition. He has received several awards for his work including the Herbert Akroyd Stuart Prize, Plummer Medal, Gzowski Medal, Duggan Medal and Prize in 1953. He is a member of the National Industrial Design Council (Canada); chairman of the Committee on Air Pollution Control. Professor Allcut served the Society as chairman, ASME Ontario Section, and as chairman ASME Power Test Codes Committee No. 16 on Gas Producers, also member ASME Committee on Air Pollution Controls.

Joseph Smith Bennett, 3rd

JOSEPH S. BENNETT, 3rd, vice-president and director, American Engineering Company, Philadelphia, Pa., is internationally known for his inventions and improvements in the field of stokers and water-cooled furnaces. From 1928 to 1940 he was in charge of design and development of coal burning, ash handling, and furnace equipment at his present company. In 1926 he designed rear waterwalls installed in four large furnaces by the Milan Edison Company in Genoa, Italy. He was one of those largely responsible for the inclined-block-covered side waterwall used extensively for multiple-retort underfeed stokers. Large waterwalls designed by him were installed in five large boilers of the London Power Company; four large boilers in the Berlin Electric System, Germany; and several in France. Other installations made were: Nine at Consolidated Gas Electric Light and Power Company, Baltimore; and with the Ohio Public Service Company; Public Service Electric Company, (N. J.); and the Philadelphia Electric Company. In the 1920's improved types of ash hoppers were developed by Mr. Bennett which were used in numerous plants. Mr. Bennett helped to develop a refractory grate for the overfeed section of the multiple-retort stoker which is still widely used. Another development was the watercooled multiple-retort underfeed stoker, now widely used. He was a leader in applying hydraulic transmissions to stoker drives in order to obtain a very wide stepless range of coal feed. Numerous applications have been made in steam generating and industrial plants. In recent years Mr. Bennett has devoted attention to steering gears, material-handling equipment, and industrial hydraulic developments. He is one of the founders and is currently chairman of the Fluid Power Systems Division of Philadelphia Section, ASME. Mr. Bennett holds 112 patents in the United States, Canada, and Europe. He is the author of numerous papers.

Harry Clow Boardman

HARRY C. BOARDMAN, director of research, Chicago Bridge and Iron Company, Chicago, Ill., has made outstanding contributions in the field of pressure-vessel design. Inspired by George Terry Horton, he has pioneered in the design of vessels of double-curvature, including spheres, spheroids, noded spheroids, and multispheres. The largest example of these vessels is the 250-ft-diam vessel housing for atomic-submarine construction at Schenectady, N. Y. Mr. Boardman has been a leader in research work to extend our knowledge of pressure vessels. This leadership has been exemplified as director of research at Chicago Bridge & Iron Company, as chairman of the Welding Research Council, and vice-chairman of the Pressure Vessel Research Committee, and as editor of the "AWS Welding Handbook." He has taken an active part in the work of the ASME Boiler and Pressure Vessel Committee. He was elected to membership on the Executive Committee in 1935 and has served on a number of its important subcommittees. Mr. Boardman was appointed chairman of the ASME Subcommittee on Unfired Pressure Vessels in 1949, a post which he held until his election to the chairmanship of the main Boiler and Pressure Vessel Committee. He is the author of several articles and of the "Handbook of Arcs, Chords, and Versines." Mr. Boardman holds 27 patents.

Louis Fussell Coffin

LOUIS F. COFFIN, assistant general manager, Bethlehem Steel Company, Sparrows Point, Md., has contributed substantially to the advancement of the science of engineering in the field of steel production. Under his specific direction and supervision, the following engineering advances were made: The study and development of treated sewage effluent to provide an additional source of industrial water for the Sparrows Point Plant of the Bethlehem Steel Company to supplement fresh water for rolling mills, without which the plant would have been seriously handicapped. Design of superior shaft bearings and gears for steel-mill machinery to hold up on heavy duty applications. Improvements in the use of refractories to give longer life and reduce substantially a major expense in the maintenance of steel-plant furnaces. He has developed new ideas and applied improved methods in solving numerous steel-plant problems and has exhibited a mastery of practical aspects of mechanical engineering in directing design and production in the second largest steel plant in the world. Mr. Coffin has contributed substantially to the advancement of engineering through his leadership among engineers and his profound interest in developing young engineers, and in his engineering-society work in the last three decades. He served as chairman of the Baltimore Section, ASME, 1939–1940, and was a member of its Executive Committee for seven years. He was president of the Association of Iron and Steel Engineers, 1937–1938; and honorary director, 1941–1955. He is the author of several technical articles.

Carl John Eckhardt

CARL JOHN ECKHARDT, professor of mechanical engineering and director of physical plant, The University of Texas, Austin, Texas, has an outstanding record as an engineering teacher. He has also made contributions as a consulting engineer in the field of design, construction,

and operation of institutional heating and power plants. His 20 years of work in the burning of Texas lignite in steam plants is a contribution toward the study of fuel conservation. Professor Eckhardt joined the teaching staff of the University of Texas in 1926. From 1929 to 1936 he was adjunct professor of mechanical engineering as well as superintendent of power plants for the University. Since 1936 he has been professor of mechanical engineering. Professor Eckhardt is the author of approximately 130 articles published in the technical press since 1934. He is the coeditor of a book of "Helpful Charts," and the author of biographies of engineers making great contributions to the development of the history of power. He is editor of an anthology entitled "These Things Will I Remember." He is also the author of a book entitled "Paths to an Abundant Life." Professor Eckhardt has served the Society as honorary chairman, ASME Student Branch of the University of Texas, and chairman of the South Texas Section in 1945–1946. He was the Speaker of the Regional Delegates Conference in 1947. More recently he served as Vice-President of ASME Region VIII, 1948–1952.

Owen William Ellis

OWEN W. ELLIS, who retired as director, department of engineering and metallurgy, Ontario Research Foundation, Toronto, Ont., Can., Dec. 31, 1954, has specialized in the field of metallurgy in its relation to engineering. He is the author of many articles in this field, and of a book, "Copper and Copper Alloys," 1947. From 1914 to 1921 he was principal assistant and later chief metallurgist in the Royal Laboratory Department of the Royal Ordnance Factories, Woolwich, England. In 1921 he joined the University of Toronto as assistant professor of the department of metallurgical engineering. He was a research fellow at the Mellon Institute of Industrial Research, Pittsburgh, Pa. in 1925–1926. From 1926 to 1929 he was employed as a research metallurgical engineer at Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. He held his position with the Ontario Research Foundation from 1929 to 1954. For ASME he has served as chairman of the Ontario Section. He was a member of the International Joint Council of ASME-EIC.

Charles Kimball Flint

CHARLES K. FLINT, director, Eastman Kodak Company, Rochester, N. Y., is an outstanding management engineer. Under his leadership the following major photographic achievements occurred at Kodak Park: Economic production of color film and paper for the amateur photographer; the change from nitrate to safety professional movie film; the supply of great quantities of sensitized products to the Government during World War II; and very great increases in production efficiency. Mr. Flint joined Kodak in 1911 as an assistant engineer. He supervised construction of the 19-story Kodak executive building in Rochester. From 1913 to 1915 he was engineer in charge of preparation of plans and erection of the Canadian Kodak plant. In 1915 he was appointed superintendent of the engineering and maintenance division at Kodak Park. He rose to be assistant Kodak Park manager in 1920; general manager of Kodak Park Works in 1935; and a vice-president of the company in 1941. Since 1945 he has been a director. In his early career he worked on the design of high-speed electric-traction railroads for Westinghouse, Church, Kerr, and Company.

Thomas Collier Gray

THOMAS C. GRAY, vice-president, Pullman-Standard Car Manufacturing Company, Chicago, Ill., has made contributions in a wide field of applied engineering. These contributions vary from steam-heat connections for railway-passenger cars to steam-distribution systems for steam locomotives. He holds patents on metallic flexible and swivel joints, internal-combustion direct-driven hammer, power-reverse gear, and variable-profile-cam valve-gear mechanism. On active service in the Navy during World War II, Captain Gray had charge of machinery design of destroyers, destroyer escorts, and patrol frigates at the Bureau of Ships. Later, he organized much of the work of the 5000 personnel Naval Repair Base at Guam, serving as Planning Officer, Production Officer, and Industrial Manager. He was awarded three citations including the Bronze Star. Mr. Gray has advanced successively as manager of engineering production, director of engineering, and vice-president of engineering of his present company. His department has developed many passenger and freight-car and component designs that are in wide use today on the railroads. He is now working on the design and construction of Train X, a new concept of lightweight passenger train with weights about one third that of the conventional. He has been responsible for many other improvements in the railway and marine field. He is the author of several railway mechanical technical articles.

Joseph Moses Juran

JOSEPH M. JURAN, consulting management engineer, Tuckahoe, N. Y., is internationally recognized as an outstanding authority in industrial management and quality control. In 1945 he was awarded the Worcester Reed Warner Gold Medal of ASME "for his outstanding contributions to the problem of quality control in mass production" and for his excellent records of such work contained in his books, "Bureaucracy, A Challenge to Better Management," Harpers, 1944; and "Management of Inspection and Quality Control," Harpers, 1945. He is the author of "Quality Control Handbook," McGraw-Hill Book Company, Inc., 1951; "Planning and Practices in Quality Control," Nippon Kagaku Gijutsu Renmei, 1954; and coauthor of "Case-book in Industrial Management," McGraw-Hill Book Company, Inc., 1955. He has had over 100 papers published in professional and technical journals. In his capacity as professor and chairman of the department of industrial engineering at the New York University, he broadened the scope of the curriculum and greatly extended it in the postgraduate field leading to the degree of doctor of engineering science. He also founded the Management Round Tables at NYU. In his consulting work he has served such companies as Gillette Safety Razor Company, Koppers Company, Bigelow-Sanford Carpet Company, Sylvania Electric Manufacturing Company, Bausch & Lomb Optical Company, Raytheon Manufacturing Company, and many others. He has lectured by invitation at the Royal Institute of Technology (Stockholm), Delft Technical University (Holland), the University of Birmingham (England), and in Japan. For ASME he served as chairman of the Management Division and chairman of the Publications Committee.

James Keith Louden

J. K. LOUDEN, vice-president and general manager, Commerical Division, York Corporation, York, Pa., has made many contributions in the fields of industrial engineering and management. His executive leadership of engineering organizations and development programs is demonstrated by his success in important positions with York Corporation. He joined this company as assistant to the president, was elected a vice-president and director of the firm. In this position he was responsible for assisting the president in the over-all operation of the business with particular emphasis and responsibility of manufacturing and engineering. At present he has full responsibility for sales, manufacturing, and engineering of all products sold through distributers. Mr. Louden is the author of a book, "Wage Incentives," 1944; coauthor of another book, "Job Evaluation;" and of numerous articles on management. For nine years he has been a lecturer on industrial and engineering management at the State University of Iowa Summer Management Course. In 1949 he was awarded the Gilbreth Medal of the Society for the Advancement of Management; he is an Honorary Life Member of SAM. Mr. Louden is a member of the Gantt Medal Board of Award and past-chairman of that Committee. He has been active in ASME affairs as chairman of the Management Division, member and past-chairman of the Meetings Committee, and ASME representative on the National Management Council.

Lester Coridon Morrow

LESTER C. MORROW, director, Special Editorial Services, McGraw-Hill Publishing Company, Inc., New York, N. Y., as a writer, speaker, and organizer has contributed greatly to the subject of industrial-plant operation and plant-maintenance engineering. He is recognized as an outstanding authority in this field in the United States and abroad. Mr. Morrow is the author of a great many published articles and editorials on industrial-plant operation. For several years he was a lecturer on the philosophy of management at the Graduate School of Business Administration, New York University. As chairman of the General Advisory Committee of the National Plant Maintenance Show and as general chairman of the Plant Maintenance and Engineering Con-

ferences whose programs he conceived and directed, he has developed, promoted, and extended the application of sound engineering principles in the field. He has participated actively in professional-management societies, having served two years as vice-president of American Management Association. He is a member of the Board of Directors of the Council for International Progress in Management. His contributions to the International Management Congresses have been noteworthy and an important part of the total American contribution. He served for 15 years on the Industrial Relations Committee of the National Association of Manufacturers and an equal period on the Industry Committee of the Silver Bay Conference on Human Relations. Since 1920 he has worked on three McGraw-Hill publications. He was managing editor of the *American Machinist*, 1920–1928; editor, *Maintenance Engineering*, 1929–1932; and editor, *Factory Management and Maintenance*, 1933–1950. He has held his present position since 1951. Mr. Morrow is consulting editor of the McGraw-Hill "Industrial Organization and Management Series" under which 51 books have been published. His ASME service includes the Publications Committee, the Executive Committee of the Management Division, and the special wartime Manufacturing Committee.

Russell William Parkinson

Russell W. Parkinson, vice-president and chief mechanical engineer, Commonwealth Associates, Inc., Jackson, Mich., is in charge of mechanical and structural design of steam-power-plant projects for his company. This represents from 500,000 to 600,000 kw of generating capacity per year. For the preceding 19 years Mr. Parkinson was with the Jackson, Mich., office of The Commonwealth & Southern Corporation of New York and its predecessor companies, handling a wide variety of steam-power-plant investigations and design. A steam cycle for steam-electric generating stations incorporating a particular arrangement and utilization of heat exchanging and deaerating equipment, and a unique condensate cycle and control, was developed by G. C. Daniels with Mr. Parkinson's assistance. Construction of the first three units for this type of station: The Bryce E. Morrow Plant, Unit 1, and John C. Weadock Plant, Unit 1, Consumers Power Company, and the New Castle Plant, Unit 1 of the Pennsylvania Power Company, were completed in 1940. Between that time and 1950, 22 installations of this type have been made. One of these, the B. C. Cobb Plant of the Consumers Power Company, was shown in the performance tabulation prepared by the Federal Power Commission as one of the top eight power plants of the country for 1949. In 1948 design of a more elaborate but similar cycle with reheat was started and three units for this type of station were put in service in 1951. Since then Mr. Parkinson has extended this type of cycle to 11 additional units including six units of 156,000-kw capacity each at 2000 psig, 1050 F, with reheat to 1000 F, of which three are now in operation and three are under construction. Mr. Parkinson has had an active and responsible part in the designing of over 3,000,000 kw of capacity in 16 plants. He is a graduate of the University of Michigan Mechanical-Engineering Class of 1923 and received a citation from the University in 1953. He is a director of Commonwealth Associates Inc., of Commonwealth Services Inc., and of Commonwealth Buildings Inc., and is the holder of a design patent on hotwell deaeration. He has served ASME as a member of the Executive Committee of the Detroit Section.

Lynn A. Scipio

Lynn A. Scipio, retired, founder and dean of Robert College School of Engineering, Constantinople, Turkey, has served a long and useful career as an engineering educator and as an American ambassador of good will in the Near East. He has also served in a number of outstanding consulting and administrative posts in the United States. Mr. Scipio taught and conducted research from 1908 to 1912 as an assistant professor of mechanical engineering at the University of Nebraska. In 1912 he was asked to organize the first foreign engineering school in the Near East. This school was the Robert College of Engineering of which he was dean until 1920. On a sabbatical leave in 1920 he served as head of the ASHVE research laboratories at the U. S. Bureau of Mines. Returning to Robert College in 1921, he served continuously as dean until 1943. During this period his outstanding leadership advanced the cause of engineering education in the Near East. In addition, his participation in engineering and civic affairs helped to foster the good will of America among the peoples in that area. From 1943–1944 Mr. Scipio served as head engineer with the War Production Board in many war research projects. In 1945 he was appointed industrial rehabilitation specialist for UNRRA in charge of technical problems connected with railway transportation and telecommunications, for all UNRRA countries. In this capacity he also planned rehabilitation of the Yangtze River in China and the clearing of the Corinth Canal in Greece. Mr. Scipio has written three books, "Elements of Machine Design," with Prof. J. D. Hoffman of Purdue University as coauthor, 1928; an "English-Turkish Technical Dictionary," 1939; and "My Thirty Years in Turkey," 1955.

Lewis Burrie Swift

Lewis Burrie Swift, chairman, Taylor Instrument Companies, Rochester, N. Y., has made valuable contributions to engineering in the field of administration. In his 50 years with Taylor Instrument he has been chiefly responsible for achieving the transition from a small company primarily making consumer products to today's complex instruments which were responsible for automatic process control long before the word "automation" was coined. Under his leadership as president during World War II, his company designed, developed, and supplied as prime contractor thousands of industrial instruments for the Manhattan Atomic Bomb Project. This, and other contributions to World War II, twice brought to the company the Army-Navy "E" Award. After the war the company continued its work of making instruments for the Atomic Energy Program under his direction. He organized Taylor's first integrated engineering department and was the company's first

Oscar Wolf, *center*, Tulsa, Okla., consulting engineer, is shown receiving a certificate of promotion to the grade of Fellow in The American Society of Mechanical Engineers. Making the presentation is W. H. Stueve, *left*, Fellow ASME, Oklahoma City, consulting engineer. At *right* is A. N. Horne, Mem. ASME, and member of the Executive Committee of the Mid-Continent Section of ASME.

chief engineer. He initiated research in industrial controls, a move which presaged the emergence of the company as a major factor in industrial control. Research and engineering-development groups headed by Mr. Swift produced many patentable systems for use in pneumatic control circuits. Under his direction an extensive line of tube-system-type measuring elements for the industrial measurement of temperature, pressure, and load was developed. This co-ordinated development of sensing and control elements led to the introduction of an extensive line of industrial instruments for the indicating, recording, and controlling of temperature, pressure, flow, liquid level, load, and humidity. Mr. Swift served as a member of the Industry Advisory Committee of the War Production Board during World War II and the Korean War. He holds eight patents.

Oscar Wolfe

Oscar Wolfe, consulting engineer (retired) for foreign operations of The Texas Company, New York, N. Y., is recognized as an authority on the hydraulic design of long-distance oil and gas pipe lines. His experience in the field of oil and gas transportation covers a period of many years, beginning in 1912 as engineer for the Southern Group of Pipe Lines in western Pennsylvania and Kentucky; from 1928 to 1933, as assistant and later chief engineer of The Texas Pipe Line Company, Houston, Texas. In 1933 he was transferred to The Texas Company in New York, N. Y., and served in a consulting capacity on projects of oil and gas transportation in the company's foreign operations, mainly in South America and in the Middle East. Among these projects were the oil pipe line from the Barco Concession to the Caribbean Coast and the Trans-Arabian pipe line while in its formative stages. During the war years Mr. Wolfe served as chief engineer for War Emergency Pipelines, Inc., in responsible charge for the technical design of the famous "Big" and "Little Inch" pipe lines which solved the critical problem of petroleum transportation along the Atlantic seaboard. He also served as a consultant for the United States Army in connection with a military pipe line built by the Armed Forces along the Ledo Road in the China-Burma theater of the war. This pipe line extended from Calcutta, India, to Kunming in China and, upon its successful completion, eliminated the hazardous transportation of aviation gasoline by plane over the "Hump" to China. Mr. Wolfe is now engaged in practice as a consulting engineer in Tulsa, Okla.

Joseph Kaye Wood

Joseph K. Wood, vice-president and chief engineer, General Spring Corporation, New York, N. Y., has contributed greatly to the various industries in the design and application of spring suspensions. In 1928 the General Spring Corporation was formed for the purpose of marketing devices invented by him, particularly those implementing his design procedure now universally used in the suspension of high-temperature piping for the elimination of weight-transfer stresses and vibration. These devices included the constant spring hanger, the spring and hydraulic sway brace, and the lateral travel support. Constant-support spring suspensions are now used on all high-temperature pipe lines with the power (including atomic), oil-refining, chemical, and marine (including naval) industries. During World War II he developed devices for the protection of life against steam and fire hazards of piping failures caused by explosive or earthquake forces, one such device being the automatic valve shutoff. Early in his career Mr. Wood served as engineer on the construction of rock and subaqueous tunnels in New York City and later in the Bell Telephone Laboratories where he initiated the precision length measurement section. Some of Mr. Wood's other activities included the investigation of the equalization system and flexible drive of Westinghouse electric locomotives and the development of the "tire"-type air spring for railway trucks and automobiles, the performance of which can be easily and accurately maintained by adjustment of the air pressure through a Schrader or similar-type tire valve (at an ordinary gasoline station for automobiles), and by changing the orifice area through remote control from the instrument panel. He proposed the formation of the Special ASME Research Committee on Mechanical Springs and served as chairman for seven years. He also served on the ASME Machine Survey Committee. Mr. Wood is the holder of many patents and has had published numerous engineering articles relating both to springs, spring suspensions, and other mechanical devices in the automotive, railway, telephone, piping, and general machine fields.

Automation Makes 30-Hour Work Week Possible

The intelligent development of automation in industry will result in giving the average worker a 30-hour work week within the next five to ten years, with no reduction in pay or standard of living.

This prediction was made by Arnold O. Beckman, president of Beckman Instruments, Inc., and chairman of the Host Committee of the national technical conference and instrument exhibition of the Instrument Society of America and ASME Instruments and Regulators Division. Held Sept. 12–16, 1955, at Shrine Exposition Hall in Los Angeles, Calif., the tenth ISA technical conference and instrument exhibition, was the first held in the West.

Some of the outstanding exhibits at the Los Angeles Show were a working model of a nuclear-reactor simulator, a new moisture detector and controller combination, computers, data-handling systems, read-out units, an ultrasonic flowmeter, and many others. Emphasis was on electronics, with data handling and related equipment attracting the greatest interest.

Technical papers presented covered such topics as process control, analytical instrumentation, testing instrumentation, education, aeronautics, transportation, medicine, and equipment maintenance.

"Automation is the keynote of this exposition," Dr. Beckman said. "The newest developments of leading instrument manufacturers throughout the nation will be on display and visitors to the exposition will be able to see automation in action—to see how automation will bring to mankind benefits undreamed of a few years ago.

"We should differentiate between mechanization and automation," he declared. "Simply stated, 'mechanization' replaced or amplified human brawn. 'Automation,' on the other hand, supplements the human brain. When you 'automate' a manufacturing process, you include what we call 'feedback' or self-correction. A simple example of this is the common room thermostat. The thermostat automatically controls the operation of a gas furnace, for instance, to compensate for changes in room temperature. When the room gets too warm, your thermostat turns off the furnace; when it gets too cool, it turns it on. A simple instrument thus relieves us of the necessity of remembering to read the thermometer, of deciding whether to turn the furnace on or off, and then of doing what is decided. This is automation."

Automation—Friend, Not Foe

"Some persons appear to be fearful of automation. They prophecy that the growth of automation will cause widespread unemployment and will work great hardship on labor," Dr. Beckman said.

"The contention that automation does not benefit human beings is absurd. As Benjamin Fairless, former chairman of the board of U. S. Steel, says, 'The facts show that only through the widest possible use of new and better machines can we hope to achieve the fullest measure of employment and a higher standard of living.'"

He pointed out that history shows that new inventions create employment. The carriage makers resisted the invention of the automobile. They said this horseless carriage would put them out of work. But, today, the automobile industry employs thousands of times more workers than did the carriage makers. In 1935 there were 408,000 workers in the automobile industry; in 1952 there were 647,000.

"There is no single example where increased mechanization, or use of automation, has had a long-lasting adverse effect. In 1880, the percentage of work energy supplied by mechanical power was 17 per cent, and the number of jobs in the U. S. totaled 17 million. In 1954, mechanical power supplied 95 per cent of the work energy, and there were 62 million jobs. In 1921, 500 refrigerators sold for $530 each. In 1950, the average price of the 6,200,000 electric refrigerators manufactured was $258. In spite of the introduction of the dial telephone, the number of telephone operators in this country increased by 159,000 or 79 per cent, from 1940 to 1950," he said.

Dr. Beckman points out that he believes

employment should not be an end in itself. He feels there is too much emphasis today on employment for employment's sake.

"If the employee can get the same goods for less work, isn't that a better goal than just insisting that he keep the same job he has had?" he asked.

Economic Changes

"Every change in our economic life causes a shift in the nature of employment. Job opportunities are constantly changing. Automation, like other technological developments, may reduce employment needs, at least temporarily, in certain types of jobs—but it will create many more new job opportunities than it will destroy.

"Automation not only will produce more jobs, it will bring about an upgrading of employees, which will benefit labor at all levels of technical skill. By enabling a worker to produce more, higher levels of income are made possible. Through automation jobs become easier, less tiring, more satisfying," Dr. Beckman declared.

"As a matter of fact, automation already has produced more jobs than can now be filled with available personnel. There is a crying need today for literally thousands of skilled and semiskilled workers to produce and operate the instruments needed for automation. No man need fear for a job if he is willing to adapt himself to the needs of the day and take advantage of the innumerable opportunities for new and better jobs which automation is creating.

"Intelligent labor leaders recognize this fact and do not foolishly fight against the inevitable progress of technological improvement. On the contrary, they welcome the increase in the standard of living, reduction in the hours of toil, and other benefits which these improvements bring about," he said.

Dr. Beckman pointed out that Walter Reuther, CIO president, said before the Executives Club in Chicago, last May 13:

"If I had time to tell you what is happening in terms of automation, you would be amazed. We now manufacture and machine an engine block without a single human hand touching it in 14.6 minutes. There are radio plants in the East where the assembly lines are automated, where two workers turn out 1000 radio sets in eight hours when it used to take two or three hundred. We welcome automation. We believe that the more progress we can make in improving the tools of production so that we can create greater and greater economic wealth with less and less human effort, that this is desirable, but we need to find a way to gear that greater production to the needs and the hopes and aspirations of the great mass of people..."

"This is precisely the point I wish to emphasize," Dr. Beckman declared.

"Automation is still in its infancy," he continued. "Despite the tremendous strides which have been made in the years since the war, new inventions foreshadow developments in automation that stagger the imagination. As an example, take the transistor. This device, which replaces an electronic tube and which already has revolutionized the hearing-aid industry, is just beginning to be used in other fields of electronics, such as radio and TV. Applications to date in instrumentation for automation have been negligible.

"This year the cost of transistors probably will go below the cost of comparable electronic tubes as the result of mass production. Transistors will provide many benefits to automation instrumentation—such as greater reliability of operation, lower-power requirement, and miniaturization. It is not unreasonable to anticipate that the transistor will revolutionize instrumentation for automation, just as it has revolutionized hearing aids," Dr. Beckman said.

Columbia Conference Stresses Need for Engineering Manpower

To keep up with the demands for engineering and science manpower "we must run as fast as we can in order to stay in the same place," Dr. Howard Meyerhoff, executive director of the Scientific Manpower Commission in Washington, D. C., told a group of 100 college and secondary-school guidance counselors at a conference sponsored by the Columbia University School of Engineering at Arden House, Harriman, N. Y., October 20.

Dr. Meyerhoff backed up his paraphrase from the Lewis Carroll story of "Alice in Wonderland" by pointing to the need for more and more engineers to operate our technological economy.

"We had only 23,300 engineers graduate in 1955 to fill a real need by industry alone of 35,000," Dr. Meyerhoff said. "We must channel more young people of high-school age into science and engineering careers and this is a problem for parents and guidance counselors. Nearly 75 per cent of our high-school population doesn't go to college, not because of lack of money but because of lack of interest.

"If we are going to have students grounded in mathematics and physics so that they are capable of going into engineering, we must have those qualified advised to do so by their guidance counselors. I think that the lack of interest in these 'hard' subjects is largely the fault of guidance counselors. I'll admit it is difficult when mathematics and physics have become elective subjects in most of the nation's high schools. A liberal education isn't liberal unless it includes courses in the sciences and mathematics.

"It is the responsibility of our secondary schools to guarantee us the 'guarantors of our technological future—the engineers,'" he stated. "To do it we must have more science teachers. We certainly can't do it in one high school where 11 music teachers are conducting science classes."

Dr. Meyerhoff spoke at the Columbia meeting which also heard Dr. John A. Krout, vice-president of the University, who talked on "Columbia's Engineering Tradition"; Dr. Evan Just, vice-president of Cyprus Mines, who spoke on "Opportunities in Mining and Mineral Engineering"; and Dr. John Holloman of the General Electric Company, who spoke on "Opportunities in Metallurgy."

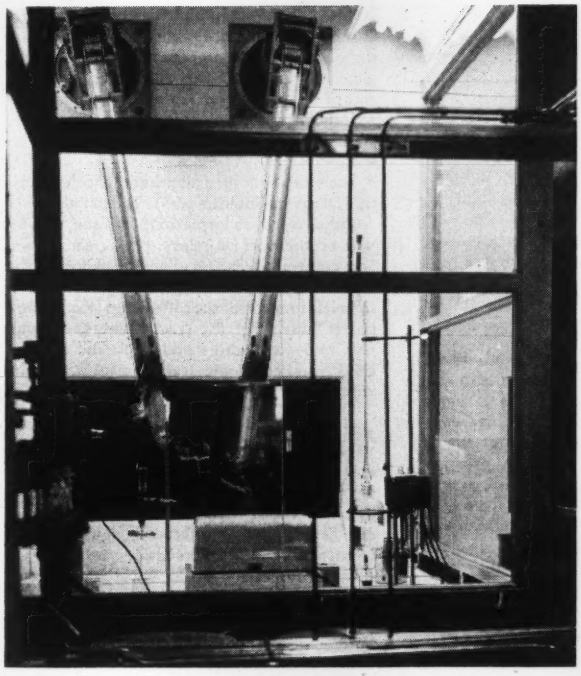
Machine-Tool Producers Must Consider Man's Needs Says Industrial Designer

Machine-tool producers must give greater attention to the man who runs the machine if they are to remain in a competitive position, according to Robert H. Hose, Mem. ASME, partner of Henry Dreyfuss, New York, N. Y., industrial designer. Mr. Hose acted as moderator for a panel, "Designing Industrial Equipment" at the eleventh annual meeting of the American Society of Industrial Designers, in Washington, D. C., October 7.

Outlining the contribution of industrial designers in this field, Mr. Hose said: "Appearance is only one of a series of considerations that the designer applies in his thinking on industrial-equipment-development programs.

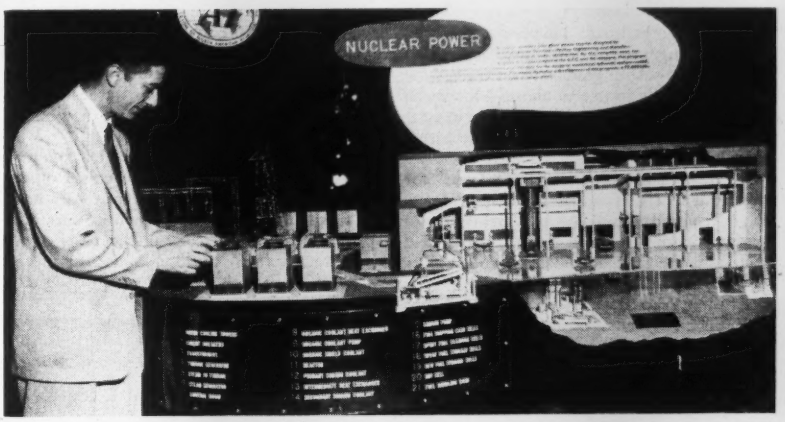
"The major problems," he said, "certainly are those pertaining to convenience of use, ease of operation, ease of maintenance, safety, cost, and, in many cases, those psychological considerations which tend to more practically integrate the efficiency of the machine and the man operating the machine. Last on the list should come appearance—that intangible which qualitatively expresses the character of the machine.

"The character of industrial equipment may be quite different appearancewise than the character of other products sold over the counter or through light commercial channels. It certainly is not important to have a heavy machine look 'high style' or cute. Those factors of design pertaining to form and function, the rightness of controls, the appropriate use of materials, the proper selection of techniques to assemble its parts, and the general character of the entire instrument as it relates to human use, are the factors which when properly combined in a physical entity express the true and right appearance of industrial equipment." Another member of the panel, J. M. Little, Toledo, Ohio, designer, concluded, "The future of the industrial designer in affecting the design of production equipment has only begun. It is now about to explode in our faces, and the shortage of qualified industrial designers is more acute than that of engineers in this field."

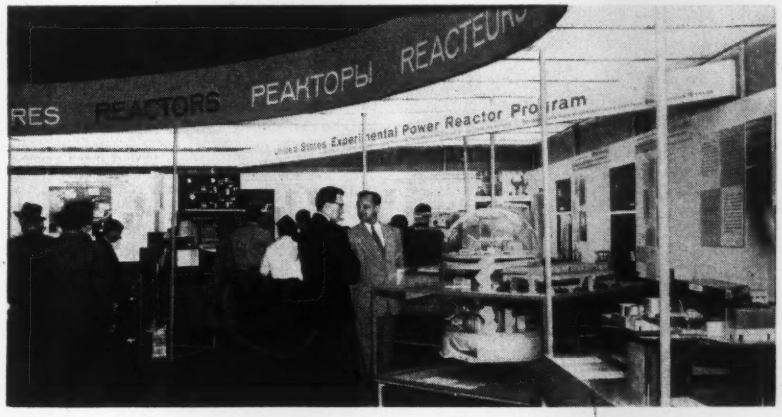


Man, the Atom, and the Future

A combined industry-government exposition stressing the uses of atomic energy for the advancement of human welfare, sponsored by the Atomic Industrial Forum, the Carnegie Endowment for International Peace, and the Fund for Peaceful Atomic Development, was on view at the Carnegie International Center, New York, N. Y., from Oct. 20 to Nov. 3, 1955. The exposition featured the U. S. Atomic Energy Commission Technical Exhibit and displays from 36 organizations in the industrial area, each active in the production and development of equipment and services for the atomic-energy field; in the application of atomic energy to industry, medicine, and research; in the spread of information in this rapidly expanding industry. The majority of the commercial exhibitors were in the group that was on display in the first U. S. Trade Fair of the Atomic Industry, held in Washington, D. C., from Sept. 26 to 30, 1955, under the management of the Atomic Industrial Forum. Shown at *left* is the hot cell, used for determining nitrate ion and uranium concentration. It includes two Argonne Model 8 manipulators, a 3-ft-thick viewing window, and analytical equipment. Most of the equipment of the three units was furnished by the Oak Ridge National Laboratory.



Model of North American's sodium-graphite pilot power reactor. It is a joint project of the AEC and the company. This program will give engineering, performance, and cost data for the design of economical, full-scale sodium-cooled graphite-moderated power reactors.



View of U. S. Atomic Energy Commission's experimental power-reactor section, shown in August, 1955, at the United Nations Conference on the Peaceful Uses of Atomic Energy in Geneva, Switzerland

Junior Forum . . .

Conducted for the National Junior Committee
by R. A. Cederberg,[1] Assoc. Mem. ASME

The Young Mechanical Engineer in Railroad Engineering

By John P. Morris[2]

THE young mechanical engineer in the railroad industry is indeed in an enviable position. There are few industries that can offer the young engineering graduate the industrial training, the advancement, and the employment benefits offered by the railroads. Any graduate who is interested in the field of railway transportation, heavy machinery, diesel or electrical power, or mechanical maintenance would truly enjoy railroad employment. Young engineers interested in this type of work and who will take the time required to serve an apprenticeship or training period with a railroad company are assured of successful and interesting lifetime employment.

Apprentice-Training Program

Most of the railroads have an apprentice-training program in continual operation whereby high-school graduates are trained for four-year periods in one of the various shop-crafts. In addition to this, the mechanical departments of the larger roads usually hire a limited number of young mechanical and electrical-engineering graduates each year for training as special apprentices. These trainees are not required to have any previous engineering experience. An engineering degree and interest in the railroad industry are the only requirements. These special apprenticeships are of three years' duration, during which time the trainee is given experience in each of the various shopcrafts thereby giving him a general over-all knowledge of the functions of each craft in the railway mechanical maintenance shops. These training programs are supervised by each shop's apprentice instructor and the railroad's supervisor of mechanical training.

Training Schedule

The training schedule of a special apprentice varies with the needs and qualifications of each individual. A trainee on the Santa Fe Railway might expect a schedule as follows:

Three months of the training program is allotted for experience in the railway's car department. This work consists mainly of structural-steel work and air-brake work on freight-car assembly lines in the larger-car construction shops. Also, some of this time is used to train the special apprentice in freight and passenger-car inspection and running (light) repair work. Brief experience in woodworking mill and freight-car interior woodworking is also obtained at this time.

Six months' experience in one of the railroad company's larger machine shops is given the trainee. Here he masters all types of machine-shop equipment ranging from lathes, automatic screw machines, and vertical turret lathes through shapers, milling machines, and portable boring bars. Valuable knowledge of the limitations of each piece of machine-shop equipment and how each will perform on the various metals is gained during this period.

Usually at this time the trainee is also given an extra month in each of the following machine-shop subdivisions: boiler work and heavy sheet-metal work, electric and gas welding, locomotive air-brake work, miscellaneous locomotive machinery work, and work equipment repair (lift trucks, shop machinery, locomotive cranes, pile drivers, and so on.)

Since the adoption of the diesel locomotive as the standard type of motive power on the Santa Fe, it has become necessary to devote at at least half of the special apprentice's training period to the maintenance of the diesel engine and the electrical transmissions used in this type of locomotive. This time is usually divided about half and half between mechanical and electrical components. At least six months are given to the repairing and complete rebuilding of the diesel engines. One month each is given to diesel power-plant governors, automatic steam-generating units, and air compressors and control-air systems.

The remaining nine months are for electrical-equipment maintenance. This comprises six months' work on inspection, cleaning, and repair of the various relays, power contactors, and control devices, and maintenance of the generators and motors. One month each is then left for each of the following: load (horse power) testing of the power plants, locomotive two-way radio installation and maintenance, and electronic train-control safety devices.

John P. Morris, general manager, mechanical department, AT&SF Railway, Chicago, Ill.

Assignments

During three months of the 36-month training program the special apprentice is assigned to either the material-inspection department, test department, or office of engineer of car construction. An apprentice assigned to material inspection works with company material inspectors, inspecting steel castings, machined parts, or complete units, such as freight cars, at the various foundries and commercial carbuilding plants before the railroad company accepts delivery of the product. In the test department the apprentice assists test-department engineers in testing various materials used by the company and assists in road tests of locomotives, cars, rails, bridges, or any of the thousands of items used by the railroad. Assignment to engineer of car-construction office generally means assisting in the design work of new car construction or rebuilding of existing rolling stock.

During the one remaining month the trainee is assigned to work with either a road foreman of engines or an assistant supervisor of diesel engines. During this month the apprentice rides locomotives in actual road service and learns firsthand just what is required of the mechanical department to get today's heavy freight and passenger trains over the road.

As was stated previously, the training program will vary with each individual and will depend on whether the special apprentice is a mechanical or electrical engineer. The schedule as outlined is, in general, followed by mechanical-engineering graduates. The electrical engineer receives more emphasis on electrical work and less on mechanical. This is usually arranged by substituting passenger-car lighting and air-conditioning work for freight-car construction work and traction motor, main generator, and coil and armature winding work for the machine-shop portion of the mechanical engineer's schedule.

During the training period, as many technical jobs as possible are assigned to the special apprentice. These generally consist of time studies or production surveys of various operations, design of special tools to aid in shop-production work, or handling of special drafting duties that may develop in connection with local shop work. Also, once each month the special apprentice is required to submit a written account of his training activities to the

[1] Westinghouse Electric Corp., Radio-Television Division, Metuchen, N. J.

[2] General Manager, Mechanical Department, AT&SF Railway, Chicago, Ill.

supervisor of mechanical training and other mechanical-department officials.

Salaries

The wages during this three-year training period, though not considered high compared with present wage scales, are about the same as most industries offer the young engineer-in-training. Considering no experience is required and the tremendous amount of mechanical training the individual receives, the dollar-for-dollar return to the trainee is as good as can be found anywhere. During the training period, if a particular type of work or training cannot be obtained at one location, the trainee will be required to move to another location to continue his training. Some trainees dislike this portion of the training program—others actually enjoy the opportunity to move. This depends on the character and make-up of the individual involved and should be carefully considered.

On completion of the three-year special apprenticeship the trainee is assigned as a mechanic. Each individual is allowed to choose whatever craft he continues to work in—usually electrician-machinist or carman. This additional shop time allows the individual to receive more experience in the craft of his preference. The wages while working in this capacity are good and compare with most young engineer trainee or drafting jobs. At the same time the individual is under observation by the railroad management. His capabilities are judged to determine the possible future course, that is, promotion to supervisory position in maintenance work or through advanced positions in design or engineering.

Due to the reluctance of young engineers to enter training programs that require them to wear overalls and work with the mechanic in the shop, the competition for advancement is very slight for those who show the interest and incentive to carry on. With the increasing trend for complete mechanization and highly technical machinery appearing in the railroad industry, the list of personnel needed to fill these technical jobs is growing steadily.

The annual wage of most mechanical-department supervisors is as good as, and in many cases better than, that received by the engineering graduate who is working in the recognized "professional" engineering job. For the individual that "fits" into the railroad-engineering picture, lifetime employment in the railroad industry cannot be equaled anywhere.

Coming Meetings . . .

Fatigue in Aircraft Structures

Columbia University's department of civil engineering and engineering mechanics and its Institute of Air Flight Structures will be joint sponsors with the Office of Scientific Research of the United States Air Force of an international conference on fatigue in aircraft structures to be held January, 1956.

Announcement of the forthcoming talks, scheduled to take place on the Columbia campus from January 30 through February 1, was made by A. M. Freudenthal, Mem. ASME, professor of civil engineering and chairman of the Organizing Committee for the conference.

The conference, to which have been invited aeronautics and materials experts from Australia, Britain, Germany, and Sweden as well as the United States, has been arranged to alert the interest of research workers and aircraft designers in solving the design and structural problems which have arisen with the coming of the jet era in aviation. Also, it is hoped that a pooling of existing information on the subject will result.

Structural stresses caused by cabin pressure in high-speed flying, while long a matter of concern to specialists, became known to the general public with the recent crashes of two British Comets, the jet airliners. It is suspected that structural failures were responsible for these disasters, which are being investigated by the British Government, and that pressure-induced wing failures are the cause of a number of other crashes of civilian and military aircraft.

ASTE Meeting and Industrial Exposition

The American Society of Tool Engineers is planning the "most comprehensive series of technical sessions in its history" for its 1956 annual meeting and exposition in Chicago. Three other major technical organizations will act as cosponsors with the Society of special joint sessions.

The Armour Research Foundation of Illinois Institute of Technology, the National Fluid Power Association, and the National Tool and Die Manufacturers Association will cosponsor individual sessions during the March 19–23 meetings.

The program will comprise around 60 papers in 30 sessions starting Monday noon, March 19, and finishing Friday afternoon, March 23.

The meeting will be held in conjunction with the ASTE Industrial Exposition in Chicago's International Amphitheatre.

ASME Standards Workshop . . .

Henry C. E. Meyer

Henry C. E. Meyer, chief engineer of Gibbs & Cox, Inc., Marine Engineers and Naval Architects, New York, N. Y., died on Aug. 18, 1955, at the age of seventy-one. Mr. Meyer was born at Antwerp, Belgium, in 1884.

Mr. Meyer attended technical schools in Belgium and England and served a six-year apprenticeship in marine engineering with Richardson, Westgarth & Company in England. He came to the United States in 1906 and for several years was assistant chief surveyor of the American Bureau of Shipping. He joined Gibbs & Cox, Inc., in 1920.

Mr. Meyer was a Life Member of The American Society of Mechanical Engineers and was a leader in the Society's marine-engineering activities. Recognized as one of the country's outstanding marine engineers, Mr. Meyer helped develop the Liberty ships and planned the standardization of geared turbine machinery for Victory ships. He received a commendation from the Navy Bureau of Ships for his work in making possible the mass production of both types of vessels.

Shortly before his death Mr. Meyer completed an outstanding contribution to ASME-sponsored activities by securing adoption of the new stress-range concept in making flexibility analyses by the American Standard Code for Pressure Piping, thus giving the piping industry a practical working solution embodying this important concept.

Mr. Meyer will long be remembered for his keen analytical mind and genial personality. He was a wise counselor and tireless worker who often succeeded in reconciling what appeared to be unsurmountable differences of technical opinion.

Executive Committee of Sectional Committee B31 on Code for Pressure Piping

Education . . .

Student Engineers Receive Awards

Lee Allgood of Grosse Pointe Woods, Mich., senior at the University of Michigan, received the $1250 first award in the 1955 competition for mechanical and structural designs by engineering students, sponsored annually by The James F. Lincoln Arc Welding Foundation of Cleveland. As a senior at the University of Michigan, he received the award for the design of a stamping die of welded construction, suitable for low-quantity production, whose cost would be only 20 per cent that of a conventionally made die.

The $1000 second award was received by Donald Croll of Franklin, Ohio, who, as a senior at the University of Cincinnati, designed a TV or radio-transmission tower of welded tubular construction for a 22 per cent weight saving.

Herman Greif of Detroit, Mich., at the University of Detroit, designed a welded shaper for which he received the $500 third award.

These awards were duplicated in scholarship funds donated by the Foundation to the schools in which the students were enrolled.

The Foundation has announced a similar competition for the 1955–1956 school year, for which the Rules are available from the Foundation in Cleveland, Ohio.

Fellowships

To help offset the dangerous cutback in science teaching at the secondary level—a basic cause for our critical shortage of graduate scientists—Shell Companies Foundation, Inc., announced a broad program of recognition fellowships for high-school teachers of science and mathematics.

The program, to be known as the Shell Merit Fellowships for High School Science and Mathematics Teachers, was developed fol-

lowing studies that showed a rapid decline in the number of college graduates entering the field of science teaching.

Through the program, worked out with the co-operation of the leading educational associations, Shell will underwrite summer seminars at Stanford and Cornell Universities for 60 teachers yearly. The Fellowship recipients, chosen on the basis of merit and demonstrated leadership qualities, will receive travel allowances, all tuition and fees, living expenses on the university campus, and $500 in cash to make up for the loss of potential summer earnings.

The Fellowships are in addition to the Shell Companies Foundation's present $350,000 aid-to-education program which includes 50 graduate fellowships and 20 grants in fundamental research in science and engineering at 41 colleges and universities.

RCA Scholarships and Fellowships

A BROCHURE giving detailed information about RCA scholarships and fellowships was recently published. The information contained covers the institutions where these scholarships and fellowships are available, eligibility, grants, and applications.

For further information write to Radio Corporation of America, Department of Information, 30 Rockefeller Plaza, New York 30, N. Y.

Literature . . .

Titanium-Production Techniques

METHODS employed by the Government in producing more than half a million pounds of titanium—one of the new "wonder metals" of the postwar period—are described in a Bureau of Mines report released by Secretary of the Interior Douglas McKay, October 3, 1955.

The publication tells of operations at the Bureau's pilot plant at Boulder City, Nev., when research and development work on the strong, corrosion-resistant, lightweight metal was needed by the Army and when Government production was required to supplement industry's output.

The report goes into greater detail than most of its type because it attempts to cover the many questions asked by scores of engineers and businessmen who visited the plant.

Using what is described as a modified Kroll process, the Bureau encountered many new problems in operating on a continuous basis. One was the prevention of leaks in equipment, since an unwanted opening as small as a pinhole could ruin an entire batch of sponge titanium.

The report covers every phase of the plant's design and operation. It tells of the precautions taken against fire and poisonous fumes, and describes every step in the production and purification of sponge metal.

A copy of R. I. 5141, "Titanium Plant at Boulder City, Nev.: Its Design and Operation," by C. T. Baroch, T. B. Kaczmarek, W. D. Barnes, L. W. Galloway, W. M. Mark, and G. A. Lee, can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa. It should be identified by number and title.

Atomic-Energy Industry

SOME of the interesting work being done at the atomic-energy center at Oak Ridge, Tenn., is described in a new 44-page booklet, "The Atom in Our Hands," which has just been published by Union Carbide and Carbon Corporation.

Included in the booklet is a description of the unique process used to separate billions of uranium atoms to capture the rare type of uranium 235 needed for atomic-energy operations. The booklet also tells how the new atomic products—radioisotopes—are produced.

The reader is given a glimpse of peaceful atoms at work in medicine, industry, and agriculture. There are also photographs of several atomic reactors, including the swimming-pool reactor built by Union Carbide for the "Atoms for Peace" Conference held in Geneva, Switzerland, this past August.

Copies of the booklet may be obtained by writing to Union Carbide and Carbon Corporation, Room 308, 30 East 42nd Street, New York 17, N. Y.

Calvin W. Rice Scholarship Fund Report

THE Calvin W. Rice Memorial Scholarship for 1955–1956 was awarded to Vasken Najarian of Lebanon. Mr. Najarian was graduated in June, 1955, with an ME degree from the American University of Beirut, School of Engineering. He was selected by the Committee from among applicants from seven foreign countries submitted for consideration by the Institute of International Education, New York, N. Y. The National Board of the Woman's Auxiliary to The American Society of Mechanical Engineers, who administer the scholarship, approved the Committee's choice at its May, 1955, meeting.

Mr. Najarian is registered at the University of California in Los Angeles as an unclassified graduate student and will study modern hydraulic machinery and equipment for water-power projects.

The Calvin W. Rice Memorial Scholarship Fund Committee is composed of the following personnel: Mrs. D. V. Minard, Mrs. L. G. Willen, Mrs. Norman W. Wyckoff, Mrs. C. Higbie Young, and Mrs. Allan R. Cullimore, who is chairman.

ASME Council Actions on 1955 National Agenda Reported

How the National Agenda Is Compiled for Regional Administrative Committees and Items Which Are Ultimately Acted on by Regional Delegates Conference

THE American Society of Mechanical Engineers has developed a procedure whereby action is taken by all Sections on suggestions made by any Section to improve policies, procedures, and operations of the Society. This procedure starts with the compilation by the National Agenda Committee of preliminary statements of the items suggested. If 15 Sections approve any one item, it is included in a National Agenda for discussion at Regional Administrative Committee meetings held in the spring. Further discussion at a national level takes place at the Regional Delegates Conference held during the Semi-Annual Meeting. The results of this Conference are then submitted to the Council.

The principal business of the Regional Delegates Conference held during the Semi-Annual Meeting is to consolidate the actions of the eight RAC meetings on the National Agenda and to report the consolidated view to the Council. Related matters frequently arise on which a consolidated view is developed or on occasion the Council may request the opinion of the RDC on a Society policy or procedure. The Council is usually in session at the same time as the RDC and provision is made for the Delegates to attend the Council Meeting.

A report of the principal actions of the Conference is made to Council for information at the Council Meeting during the current Semi-Annual Meeting. The Council studies the full set of final minutes when prepared, referring to the various administrative agencies of the Society the different items with which those agencies are concerned.

The actions of Council on the Recommendations of the RDC are reported to the Delegates and to the Section Executive Committees before the next RAC meetings. Thus the cycle from origination of items by the Sections to action by Council is completed within one year.

Compilation of the National Agenda

About September 1 of each year the chairman of the Agenda Committee sends forms to the Sections and requests the submission of items by October 31.

Upon receipt of the items, the Agenda Committee reviews them, corresponds with the suggesting Section, and refers the items that can be dealt with promptly, as administrative matters, to the proper administrative agency.

On December 21 a compilation of all items passed by the committee is sent to the Sections for an expression of opinion as to inclusion in the final agenda. By the end of February the Agenda chairman must have all the opinions. Twenty-five per cent of the Sections must approve an item before it can become a part of the National Agenda, which is sent out to all the Sections at least four weeks in advance of the first RAC meeting.

Action in the Sections

The National Agenda requires action in the Section Executive Committee on at least three points:

A In the original suggestion of items. In this process it is desirable to canvass member opinion by some method, by mail, or at a Section meeting.
B The expression of opinion about including an item in the National Agenda.
C A determination of the position the Section is to take on the items in the National Agenda.

It is generally desirable for the Section to select its representatives to the RAC meeting at an early date so that they may be in touch with entire process of developing the National Agenda.

Copies of this report are available by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

A summary of actions by the Council on recommendations of the 1955 Regional Delegates Conference (Boston, Mass.) follows.

Final Report on 1955 RDC Recommendations

Agenda Topic No. 3: It is recommended that all proposed ASME Organization changes "involving a departure from usual custom" whether suggested by the Organization Committee or others, pass through Regional Administrative Committee meetings and the Regional Delegates Conference for careful consideration and decision by Sections and Regions for presentation to Council, before final decision is made by Council.

Delegates' Action: APPROVED 9 to 4

Council Action: The Council believes that adequate machinery and channels now exist for the processing of major ASME organizational changes; that the Vice-Presidents, who represent the Regions, and Sections, and Student Branches on the Council, should be cognizant of their region sentiments and could request postponement of any action materially affecting Regions, Sections, and Student Branches; and that the need is one of improving communications throughout the Society to effect any change in existing procedures.

Agenda Topic No. 11: It is proposed that the listing of new membership applications and change in grade applicants be broken down by States when published in MECHANICAL ENGINEERING.

Delegates' Action: APPROVED 9 to 6

Council Action: The Council approves this change which will go into effect in the January, 1956, issue of MECHANICAL ENGINEERING.

Agenda Topic No. 17: It is proposed that continuing financial support be given by the Society to the *Applied Mechanics Reviews*.

Delegates' Action: APPROVED 8 to 6

Council Action: Applied Mechanics Reviews which ASME has sponsored since 1947 has been supported by the Office of Naval Research, Air Research Center, National Science Foundation, Engineering Foundation, and the Research Corporation, with substantial help from the ASME Development Fund. It is an extremely valuable publication but in a limited area. Five USA societies joined in sponsoring the publication but each has refused to support it financially, so their sponsorship is being withdrawn. Council has approved increased subscription rates for 1956 and when the effect of these rates is known, the Council will again consider the need for further support.

Agenda Topic No. 21: It is proposed that frequent progress reports of ASME-sponsored research be published in MECHANICAL ENGINEERING. Also that more outside publicity be given to ASME-sponsored research.

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The Council agrees that news stories about the status of research projects are desirable, both for publication in MECHANICAL ENGINEERING and for providing the basis for outside publicity and requests the Research Executive Committee and the Secretary's office to provide them.

Agenda Topic No. 41: It is proposed that the policy of waiving initiation fees for members of other technical societies be extended to additional societies as Council sees fit.

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The Council approves the policy suggested. The Council has approved reciprocal agreements with two societies for waiving initiation fees, namely, the American Institute of Electrical Engineers and The Engineering Institute of Canada, the latter effective October 1, 1955. The Council will consider societies as the opportunity warrants. The Council requests the Board on Membership to initiate aggressive action with other societies.

Agenda Topic No. 43: It is proposed that all Professional Divisions present an annual paper to be published in MECHANICAL ENGINEERING, reviewing progress in their respective fields and quoting all pertinent literature.

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The Council believes that this is a desirable objective for each Division and that the Professional Divisions Committee should encourage all Divisions to devise the best means of periodically keeping members of the Society posted on major trends and developments in their fields.

Agenda Topic No. 46: It is proposed that Council request EJC to continue to attempt the development of a plan to further the unification of the engineering profession including individual membership, vested with power to act promptly and provided with a sound plan of financing.

Delegates' Action: APPROVED 11 to 4

Council Action: ASME, through its representatives on Engineers Joint Council, is actively continuing its efforts to make EJC the unity organization of the entire engineering profession and to include therein a provision for individual membership. EJC has already made real progress in this direction by embracing additional national engineering societies, and it is now proceeding to add local and regional organizations. The provision for individual membership in EJC, which is opposed by a strong minority of other societies in EJC (a three-quarter vote is required), is to be restudied with the hope of reaching a satisfactory agreement.

Agenda Topic No. 47: It is proposed that ASME exert all possible influence on EJC to expedite the program of unification of the engineering profession. Mr. Ketchum moved and Mr. Heumann seconded that this item be considered only as it appears in the RDC Agenda since a minor conflict appeared between this Agenda Item and the Second Compilation. The motion was carried unanimously.

Delegates' Action: APPROVED 10 to 5

Council Action: See 46

Agenda Topic No. 48: It is proposed that more vigorous action be taken in the establishment of the unity organization.

Delegates' Conference: APPROVED 11 to 3

Council Action: See 46

Agenda Topic No. 55: It is proposed that ASME institute a public-relations campaign designed to acquaint industrial management with the importance of ASME membership for its employees.

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The Council has approved an accelerated membership-development program which contains provisions for acquainting industrial management with the importance of ASME membership for its employees. The Council is also reconsidering the present public-relations program with this recommendation in mind.

Agenda Topic No. 27A: That Part V, Sec. 44, Par. 3, last sentence of Regional Operation (ML 12) be amended to read "at least 25 per cent of the Sections must approve an item before it can become a part of the National Agenda. . ."

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The Council generally follows the policy of permitting the Regional Delegates Conference to organize its own procedures. As a matter of form, the suggested amendment to the Manual on Regional Operation is approved.

Agenda Topic No. 50 through 52: It is proposed that the Society define its responsibilities to its membership as far as conditions of employment, unionization, and advocacy of labor legislation is concerned.

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The Council has approved a program to review thoroughly the present aims and objectives and this recommendation will be considered in this review.

Agenda Topic N-1: It is proposed that upon award of Life Membership to a member, the national office of the Society shall notify the member that such Life Membership has

been granted, and mail the Life Membership card to the Section Chairman for presentation to the member, except in instances where a Section has requested that they be mailed direct to members.

Delegates' Action: APPROVED 15 to 1

Council Action: The procedure suggested was followed at one time and stopped because of the delay by the Sections in bestowing the cards. Council approves a procedure of sending the cards directly to the new Life Member over the signature of the President and informing the Sections so they may arrange presentation ceremonies if they desire.

Agenda Topic N-2: It is proposed that the Vice-Presidents provide a method to help defray the expense of the Faculty Adviser to the Regional Student Conference.

Delegates' Action: APPROVED 12 to 3

Council Action: Referred to the Vice-Presidents for report at November, 1955, Council Meeting.

New Item

Agenda Topic: It is proposed that at the time a member is notified he is about to become delinquent, a copy of this notification be sent to his Section so that an effort may be made to get him to pay his dues.

Delegates' Action: APPROVED UNANIMOUSLY

Council Action: The present procedure requires that the blue dues statement indicating delinquency be sent to the Section in January to permit personal follow-up prior to March 1 date when delinquents are dropped. This notification will be sent to the Sections in December simultaneously with the mailing of the statements to the members.

Items Rejected

To complete the record, the following items that appeared on the original agenda for the Regional Administrative Committee meetings were rejected:

No. 30—14.161; Alternate Item 10; Alternate Item 22; and Item N-3.

Actions of the ASME Executive Committee

At a Meeting at Headquarters on Oct. 18, 1955

A MEETING of the Executive Committee of the Council, held on Oct. 18, 1955, in the rooms of the Society, was called to order at 9:30 a.m. David W. R. Morgan, chairman, presided. Also present were: F. L. Bradley, Thompson Chandler, A. C. Pasini, and W. F. Thompson of the Executive Committee; J. L. Kopf, treasurer; E. J. Kates, assistant treasurer; J. W. Barker, president-elect, chairman, Organization Committee; W. H. Byrne, vice-president; R. B. Lea, H. C. R. Carlson, Joseph Pope, directors; C. E. Davies, secretary, O. B. Schier, 2nd, assistant secretary, and D. C. A. Bosworth, assistant secretary.

ASME Staff Members

The Committee voted to extend to C. E. Davies, Marie J. Mullan, Leslie Scanlan, and Benjamin Theroux, members of the staff for thirty-five years, and to Jean Meyer, member of the staff for thirty years, sincere appreciation of their loyal and faithful services and their valuable contributions to the success of the Society.

Membership

As of Sept. 30, 1955, 61 members of the Society became dues-exempt, having paid dues for 35 years and having reached the age of 65 years, in accordance with Article B5, Par. 12. Also, 73 who purchased Life Membership are now members of the "Old Guard."

1955 Regional Delegates Conference

The recommendations of the 1955 Regional Delegates Conference were submitted to the committees concerned for information and action. The Executive Committee of the Council voted to adopt the statements and the actions on the recommendations of the 1955 Regional Delegates Conference. The recommendations and actions of the Council on them will be found on pages 1166–1168 of this issue.

Membership-Survey Questionnaire

A questionnaire, to obtain facts about the members' specialized interests and activities in order to improve service to the membership, was mailed to 36,741 members in July, 1954. The responses received from 20,575 (56 percent) serve as a basis for studies of improvement in Professional Divisions organization, publications policy, and planning programs for national, regional, and sectional meetings and conferences. Complete tabulations and certain special correlations of responses were distributed to the Council, and to Boards and Committees interested, as well as to the Regional Committee chairmen and secretaries and delegates to the RAC meetings. A summary of the responses appeared in the March and April, 1955, issues of MECHANICAL ENGINEERING. A subcommittee of the Organization Committee supervised this survey. The work has been completed and the committee has been relieved.

Sections

Vice-President Shumaker reported that the following boundaries for the Shreveport Subsection have been established: Arkansas—Sevier, Howard, Hempstead, Nevada, Quachita, Calhoun, Little River, Miller, Lafayette, Columbia, and Union. Louisiana—Caddo, Bossier, Webster, Claiborne, DeSoto, Red River, and Bienville.

Baker Gift to Cleveland Section

At its meeting on Sept. 22, 1955, the Executive Committee authorized the transfer of the gift of $500 received from Mrs. Walter C. Baker, to the Cleveland Section for administration. This has been done and the Secretary reported a letter of appreciation from the Chairman of the Cleveland Section.

Student Relationships

The Secretary reported that the Mexico Section had requested the establishment of "Student Associates" in the Mexico Section. Vice-President C. H. Shumaker requested that the Council consider the matter at its Nov. 13–14, 1955, meeting in Chicago.

The Secretary reported a communication from Dean L. M. K. Boelter of the University of California, Los Angeles, describing the conditions under which the establishment of an ASME Student Branch would be permitted.

The Executive Committee of the Council voted to designate a special committee to review the problems of (1) Student Associates in the Mexico Section, and (2) Student Branch at UCLA, and make recommendations at the November meeting of the Council. The following were appointed to serve on this Committee: J. B. Jones, C. H. Shumaker, and V. A. Peterson.

Certificates of Award

Certificates of Award were granted to J. Walton Angstadt, chairman of the Buffalo Section, 1953–1954, and to E. W. Nelson (Anthracite-Lehigh Valley), L. K. Mundth (Arizona), R. N. Benjamin (Atlanta), H. W. Whiting (Buffalo), B. G. Evans (Central Indiana), J. M. Johnson (Chattanooga), Charles Richards (Cleveland), Harvey Bumgardner (Detroit), N. N. Sacks (Iowa-Illinois), F. C. Kuska (Nebraska), D. G. Darling (Ontario), R. B. Parker (Providence), D. C. Nethercut (Rocky Mountain), W. J. Woodruff (St. Louis), P. G. Carlson (San Diego), G. S. Drysdale (San Francisco), J. T. Moore (Shreveport Subsection), C. H. Neiman, Jr. (Susquehanna), and D. L. Block (Youngstown).

Ballot for Election of Officers

President Morgan reported the receipt of a letter from J. A. McLennan of Homewood, Ala., making three constructive suggestions that were prompted by the ballot procedure for election of officers. Two of his suggestions dealt with improved participation in Section activities and the third suggested that the material mailed to the members with the ballot should include the biographies of the candidates. The two suggestions about the Section operation will be placed before the Vice-Presidents.

The Executive Committee discussed the third suggestion at some length and came to the conclusion that on the ballot there should be a clear statement that the biographies of the candidates appear in the August issue of MECHANICAL ENGINEERING which reaches the members at about the same time they receive the ballot. The Secretary was asked to ex-

press appreciation to Mr. McLennan for his thoughtful suggestions.

New Engineering Center

The Task Committee composed of 15 members to study and recommend a site for the new Engineering Center completed the selection of its personnel on Oct. 1, 1955, and held its first meeting on October 10. At that time B. F. Dodge, president of the American Institute of Chemical Engineers, was elected chairman and H. DeWitt Smith, president of the American Institute of Mining and Metallurgical Engineers, temporary secretary.

Engineers' Council For Professional Development

In 1954 the Education Committee of ECPD departed somewhat from previous practice in attempting to establish more quantitative criteria as to engineering-curriculums content desired for accreditation. A statement issued by the Committee establishing designations of Major Engineering Curricula and Cognate (Fringe) Curricula resulted in considerable dissatisfaction on the part of some of the constituent societies of ECPD. In view of this dissatisfaction, the ECPD Education Committee drafted a new statement. The Council of ECPD approved this statement at its annual meeting in Toronto, Ont., Can., Oct. 13–14, 1955.

Institution Of Mechanical Engineers

A selected list of members of The Institution of Mechanical Engineers have for some years been enjoying the facilities which the ASME Ontario Section have extended to them at no cost either to the IME or to the members concerned. The ASME and IME have agreed that this situation is an unsatisfactory one. The facilities involve expenditures, the arrangement has been an unofficial one and has applied only to about 36 members of the IME out of a total of about 200 members in Ontario. The Executive Committee of the Council tabled this for the present.

Mack Printing Company

The Secretary reported that the plant of the Mack Printing Company, Easton, Pa., where several of the publications of the Society are printed, was closed down during Hurricane Diane due to power outage. This resulted in delay in the mailing of the October issue of MECHANICAL ENGINEERING and mailing of the Annual Meeting programs to the members. The Executive Committee of the Council voted to express the appreciation of the Society for the efforts of the Mack Printing Company and its employees to overcome the delays caused by the hurricane disaster.

Telegram to President Eisenhower

The President reported that he had sent a telegram to President Eisenhower expressing concern at his illness and the best wishes of the members of the Society for a speedy recovery and had received an acknowledgment signed personally by "Mamie Doud Eisenhower."

Death of Honorary Member

The Executive Committee noted with regret the death, on Sept. 22, 1955, of Major William H. Tschappat who was elected to Honorary Membership in the Society in 1938.

Appointments

The Executive Committee of the Council voted to approve appointments on Boards, Committees, and Joint Activities. These appointments will be included in the Society's Annual AC-10, Personnel of Council, Boards, and Committees, which will be issued early in 1956.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th St.

Chicago
84 East Randolph St.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.

Men Available[1]

Supervisory Mechanical Engineer, 35; BSME; creative ability, analytical ability, and supervisory experience related to applied research, development, and design of mechanical, electrical, and hydrodynamic equipment. Desires challenging position of responsibility. Me-269.

Production-Control Supervisor, 33; BME; MIE; PhD (1/3 complete); business administration. Seven years' experience production control and project supervision in transportation and electromechanical manufacturing industries. Me-270.

Engineer, 29; BSME; MS Mgt. E.; seven years' diversified mechanical and electromechanical design, development, process control, quality control, government contracts, procurement, inspection. Completing two-year tour of duty U.S.N., March, 1956. Seeks technical management position in N. J. or New York, N. Y. Me-271.

Executive Engineer, 31; BS(ME); MS in business and engineering administration. Top references. Design and development experience, production control, inventory control, quality control, job evaluation, wage survey, operating standards, costs, purchasing. Seeks position as plant manager or administrative engineer. Me-272.

Executive, Administrative Engineer, 48; 25 years of successful engineering, power, maintenance and development; some production and control; principally pulp and paper. Mechanical and chemical graduate, registered. Family. Me-273.

Mechanical Engineer, 33; BME; MS; ScD; six years' experience in college teaching mechanical-engineering subjects; five years' industrial experience in heat transfer, fluid mechanics, aerodynamics, stress analysis; currently section head. Desires administrative position in research or teaching. Me-274.

Plant Superintendent, Power-Plant Supervisor, 47, married, family; 25 years' experience in central and industrial steam-power plants. Good background in automatic control systems, boiler operation, maintenance, and test. Location immaterial. Me-276.

Industrial Engineer, 33, single; will travel; Cornell. Seven years consulting including five years project supervision. Methods, equipment, layout, controls, incentives. Three years production. Desires chief industrial engineer. New York area. Me-277.

[1] All men listed hold some form of ASME membership.

Positions Available

Mechanical Development Engineer, under 40, analytical ability and strong on theory and calculations. Engineering degree, experience in shop practice, and previous work in any phase of thermomechanical product design, development and/or testing. Salary open. Northern N. J. W-2285.

Engineers. (*a*) Power-plant engineer, 30–35, mechanical graduate, ten years' experience. Good background in all phases of design of industrial steam-power plants, including heat-balance calculations and economic studies. Supervisory experience at project-engineer level. Operating experience desirable. Advanced degree. Up to $8400. (*b*) Junior power-plant engineer, under 28, mechanical graduate, up to two years' experience, to make calculations, heat balances, size equipment, write specifications, and follow through on industrial steam-power-plant projects under direction of a project engineer. Up to $5400. (*c*) Assistant chief draftsman, 30–35, mechanical graduate, minimum experience including one year of field construction and five years' drafting experience with one year at supervisory level. Responsible for selection and training of draftsmen, drafting standards, production and schedules, and supervising a drafting department. Up to $7800. Pa. (*d*) Piping engineers, degree preferred, five years' piping-design experience of carbon-steel pipe for process or refining units and five years' field-construction experience. Knowledge of codes, welding procedures, etc. Salary open. East. W-2287.

Hydraulic Designers, mechanical graduates, hydraulic design and test experience, for aircraft industry. Prefer four years' hydraulic-design experience, one year's equivalent with electronic-gear experience. $8400–$9000. West Coast. W-2290.

Manufacturing Executive, to 45, for furniture and appliance manufacturer, capable of directing two plants covering styling, production, costs, sales, and finance. Must know retail and institutional distribution and have knowledge of design trends, appliance, and household-goods markets, and distribution methods. $25,000–$30,000, plus incentives. New York, N. Y. W-2298.

Mechanical Engineer, preferably mechanical graduate, to take charge of small engineering department for manufacturer of restaurant appliances, both gas and electric. Will be responsible for development of new products, the making of models, servicing toolroom, etc. Must have some knowledge of winding electrical-heating elements; some knowledge of gas combustion. Salary open. Northern N. J. W-2320.

Engineers. (*a*) Manager of industrial engi-

neering, mechanical or industrial graduate, minimum of eight years' industrial-engineering experience, some of which must be in sheet-metal fabrication. Responsible for the efficient operation of the industrial-engineering department, reviewing product design, derermine manufacturing methods, tool and die design, and procurement; machine and equipment specifications, etc. $12,000–$15,000. (*b*) Assistant to manager, coil sales, graduate, minimum of two years' experience with heat-transfer equipment and fluid flow. Will assist in planning sales program, presenting new ideas for product development and improvement, etc. Products worked with will be heating and cooling coils. (*c*) Intermediate industrial engineer, mechanical or industrial graduate, with one to three years' tooling and methods experience. Will assist senior industrial engineer in solving production problems. Detailed planning concerning methods, tooling, and plant layout; estimate manufacturing costs, etc. (*d*) Project engineer, high-temperature heat exchangers, mechanical or metallurgical graduate, experience with brazing and welding, particularly with high-temperature materials. Will direct program of development work on brazed stainless-steel heat exchangers. Salary open. Midwest. W-2322.

Engineers. (*a*) Project engineer, mechanical graduate, background in machine design for company manufacturing machine tools. To $8500. (*b*) Machine designer, three to five years' experience in design of automatic machines. To $7800. Philadelphia, Pa. W-2340.

Mechanical Engineer to handle specialized work in the engineering design of high-pressure chemical-plant equipment, i.e., equipment operating up to 10,000 psi. Should have sound experience in high-pressure equipment design, preferably with actual operating experience with this kind of equipment. Salary open. Ohio. W-2343.

Assistant to Production Manager, under 38, chemical or mechanical-engineering graduate, methods improvement and production analysis experience in process and packaging fields. Product experience in injection molding desirable. $7000–$8000. Northern N. J. W-2344.

Methods and Production Engineer, young, mechanical or industrial-engineering training and experience in jewelry industry, including casting and brazing. $5000–$6000. New York, N. Y. W-2346.

Materials-Handling Engineer, 40–45, heavy experience in conveyers and plant layout. Will act as technical consultant on problems involving these fields. Should be willing to travel for multiplant corporation, as required. $10,000–$15,000. East. W-2347–D-9818.

Chief Engineer, mechanical graduate, 45–50, to take charge of central engineering organization, including modification of equipment, processing new products, cost reduction, plant additions, etc., for multiplant operations. Experience with mixers, mills, calenders, plastics desirable. $15,000. Northern N. J. W-2362.

Chief Engineer, preferably mechanical graduate, about ten years' machinery-design experience covering food-processing machinery, bakery equipment, and conveyers. $8000–$10,000. New York, N. Y. W-2374.

Production Engineer, time and motion study, cost analysis, methods, and some automation experience for small manufacturer of wiring devices and electrical accessories. $6000. Brooklyn, N. Y. W-2375.

Plant Manager, 40–45, mechanical or metallurgical-engineering graduate, at least ten years' management and production-engineering experience in manufacture of small electromechanical devices. $15,000–$18,000. N. J. W-2377.

Vice-President of Manufacturing, for a manufacturer of heavy machinery; 40 up, degree in business administration, engineering, or equivalent, background of metalworking industries. Desirable the last five years should have been at a comparable level of operation. Should have specific knowledge in two or more of the following fields: Electric-furnace steel, iron and steel foundry practice, machine-tool production, automotive manufacture; should understand the control techniques required for both shop and continuous operation. Liberal salary commensurate with experience, plus all benefits. East. W-2384.

Plant-Project Engineer, 33–36, mechanical graduate, experience mainly in plant engineering and maintenance, to work in central engineering associating himself closely with the plant engineer. Position will lead to that of plant engineer within a year or so. Salary open. Northern N. J. W-2387.

Manager, Systems Department, for company engaged in the development, manufacture, and sale of high-vacuum equipment. Should be 45–55, experience in high vacuum helpful, and administrative or supervisory experience. Will oversee complete operations of the department, the preparation of quotations, approve designs and specifications, and assist other personnel in contract negotiations, etc. $10,000–$12,000. Upstate N. Y. W-2391.

Plant Superintendent, mechanical graduate, responsible for all maintenance work, power operations, grounds, and automotive equipment, as well as line authority over the housekeeping and laundry departments for a hospital. Del. W-2395.

Engineers. (*a*) Product-design manager, 35–40, mechanical graduate, industrial and aircraft experience in mechanical-control fields, including various modifications of flexible drives. $7600–$12,000. (*b*) Quality-control manager, 35–40, mechanical or industrial-engineering graduate, at least five years statistical supervisory, methods improvement, and general shop inspection. $7600–$12,000. Eastern Pa. W-2399.

Plant Engineer, young, mechanical or chemical graduate, for manufacturer of rock-wool insulation. Will design new equipment, supervise installation of new equipment, and take charge of plant maintenance. Will report to plant manager. Excellent opportunity for advancement. Salary open. N. J. W-2407.

Rating Engineer, mechanical-engineering training and experience on specifications and application of heat exchangers in power and process industries. Salary open. Western N. Y. State. W-2418.

Senior Stress Analyst, graduate, three to five years' experience in either aircraft or guided-missile work. $10,000. N. Y. metropolitan area. W-2421.

Mechanical-Optical Design Engineer, either BS and ten year's experience, MS plus five years' experience, or PhD and three years' experience; specializing in small instruments and/or optic or mechanical design. Experience in designing movie camera, phototheodolites, aerial cameras, or other optical mechanical systems. Background in optics need not be extensive. $8000–$10,000. Upstate N. Y. W-2428.

Sales Manager, 35–45, mechanical-engineering experience, to handle sales for manufacturer of machinery and parts for the concrete-products industry. $10,000. N. J. W-2435.

Materials-Handling Engineer, 35–45, experience in plant layout and materials-handling equipment for manufacturing-service division in multiplant operation. Considerable traveling. $7500–$8500. Headquarters, N. Y. State. W-2436.

Senior Test Engineer, mechanical graduate, at least five years' design and development experience in gas-turbine power-plant field covering design of test equipment and instrumentation, preparation of tests, analysis of performance data, and reports. $9000. Md. W-2440.

Mechanical Engineer, experienced in stress and vibration analysis of wheels, disks, impellers, rotors used in high-speed turbomachinery. BSME plus three years' experience in related work preferred. To $9600. Liberal relocation allowance. Calif. W-2452.

Teaching Personnel. (*a*) Instructor and assistant professor in mechanical engineering, to teach heat-power subjects, manufacturing processes, or design. Opportunity to study for graduate degree. Salary dependent on qualifications. (*b*) Associate professor, to teach and develop courses in the field of metallurgy. PhD degree and teaching experience desirable. Salary open. Southwest. W-2459.

Designer, 40–50, mechanical engineer, five years' experience in designing construction machinery. Knowledge of complete unit and speeds. Will design construction equipment and later supervise other engineers for a manufacturer of construction equipment. To $12,000. Employer will negotiate placement fee. Ill. C-3933.

Design Specialist, 28–48, three years' experience in high-pressure equipment design. Should know ASME code. Will do special design of very high-pressure process equipment and piping for chemical-plant operation. No board work. $12,000. Employer will pay one half of fee. Ohio. C-4012.

Candidates for Membership and Transfer in the ASME

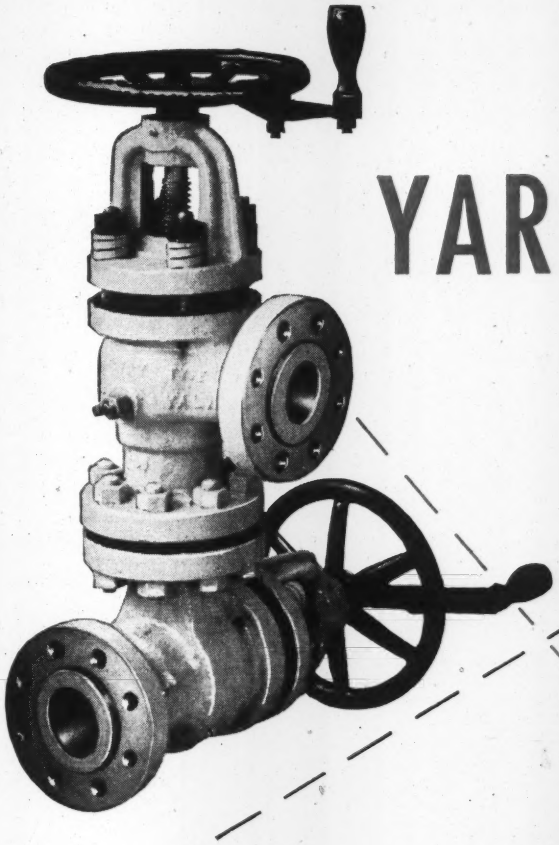
THE application of each of the candidates listed below is to be voted on after Dec. 23, 1955, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any Member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications

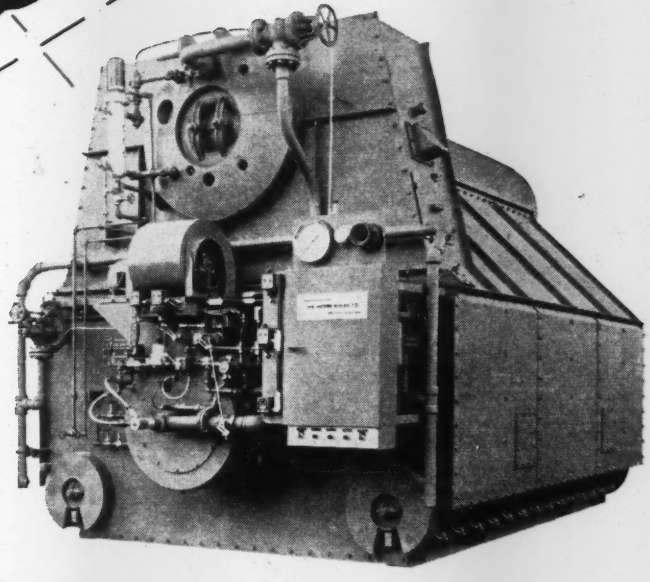
For Member, Associate Member, or Affiliate

AFFELDT, RICHARD B., Canton, Ohio
ANDERSON, HAROLD R., Phoenix, Ariz.
ANDRESEN, RAYMOND A., Port Chester, N. Y.
ARMOUR, SAMUEL F., Lynn, Mass.
ARNOLD, RICHARD, Cleveland Heights, Ohio
ARRASMITH, GRANT H., Pearl River, N. Y.
BALL, EMMETT, B., Bossier City, La.
BANKOFF, SEYMOUR G., Terre Haute, Ind.
BATESON, ROBERT N., Albuquerque, N. Mex.
BERG, RENE, Forest Hills, L. I., N. Y.
BONNEAU, LOUIS P., Quebec, P. Q., Can.
BURNS, KENNETH H., El Dorado, Ark.
CAMETTI, BENJAMIN, Pittsburgh, Pa.
CAPRYE, CHARLES E., Spokane, Wash.
CHALABI, BADRI B., Newark, Del.
COLBERT, MORTON J., Cincinnati, Ohio
COLLINS, JAMES M., New York, N. Y.
CORDIANO, HUGO V., Brooklyn, N. Y.
CRAIG, DWIGHT R., Mt. Vernon, Ohio
CUNNINGHAM, JOHN A., Wellsville, N. Y.
DARNELL, CARL W., Albany, N. Y.
DAVIS, BASIL V., Kingston, Jamaica, B.W.I.
DAVIS, JAMES F., Decatur, Ga.
DEGEN, JOSEPH, Poughkeepsie, N. Y.
DERBY, JOHN L., Erie, Pa.
DOWELL, ROBERT W., Charleston, W. Va.
DUCHACEK, HOWARD, Burlington, Vt.
DUFKA, RUDOLPH F., Baltimore, Md.
DUGAN, PAUL M., Albuquerque, N. Mex.
DUMBELIUK-C., MIHAIL W. G., San Francisco, Calif.
DURSO, EUGENE M., So. Ozone Park, L. I., N. Y.
EARTHMAN, JAMES, Houston, Texas
EDWARDS, LONNIE L., Dumfries, Va.
ERKES, PIERRE A., Brussels, Belgium
EVANS, CHARLES E., Marblehead, Mass.
FAGAN, RUSSELL J., Milwaukee, Wis.
FICOCIELLO, ALFRED, Passaic, N. J.
FLEMMING, THOMAS W., Euclid, Ohio
FLETTRICH, HAROLD L., New Orleans, La.
FRANK, LLOYD H., Kansas City, Mo.
GALLOGLY, DENNIS L., Mount Vernon, Ohio
GALLUP, MILTON, Thorndale, Pa.
GALSON, ALLEN E., San Jose, Calif.
GELMAN, MORRIS, New York, N. Y.
GEORGE, VINCENT A., Endicott, N. Y.
GOLAN, SIMCHA, Berkeley, Calif.
HAINES, JOHN K., Glen Burnie, Md.
HALLENCREUTZ, ARNE, New York, N. Y.
HARRISON, WALTER K., JR., Cincinnati, Ohio
HAYES, ROBERT B., West Orange, N. J.
HEATH, JOHN W., Lakewood, Ohio
HENKEL, HAROLD W., Cincinnati, Ohio
HEXAMER, HOMER L., Canton, Ohio
HOLMES, HAROLD E., Canton, Mass.
HOOTON, EDWARD, JR., Wilmington, Del.
HORTON, EMMETT W., JR., Warehouse Point Conn.
HOWATT, HERBERT L., Fairlawn, N. J.
HOWELL, ARTHUR K., JR., Clayton, Mo.
HURLEY, EDMOND E., Tulsa, Okla.
JACOB, JAMES P., Waverly, Ohio
JEROTHE, RUDOLPH A., Paterson, N. J.
JOHNSON, EDWARD W., Springfield, Va.
JOHNSON, LLOYD E., East Peoria, Ill.
KISH, NICK W., Barberton, Ohio
KNOLL, HENRY L., Oakland, Calif.
KOLTS, EDWARD H., Richland, Wash.
KONTZ, JOHN L., McKeesport, Pa.
LAUER, JOSEF A., Massillon, Ohio
LINDMAN, MORRIS W., West Hyattsville, Md.
LINDSAY, LESLIE C., La Marque, Texas
LO, ROBERT K., Chicago, Ill.
LOHDEN, CHARLES G., Kansas City, Mo.
MA, BENJAMIN M., Ada, Ohio
MATTHEWS, JOHN R., Charleston, W. Va.
MCKEEVER, HARRY A., Longview, Wash.
MEYERS, SHELDON, Pittsburgh, Pa.
MILLER, LEE D., Cleveland, Ohio
MOCK, FRANK C., South Bend, Ind.
MOODY, DAVID W., JR., S. Charleston, W. Va.
MOSSMAN, JOHNSON, Denver, Colo.
NICHOLS, HERBERT E., Cincinnati, Ohio
OGDEN, JOHN W., Texas City, Texas
OLLENDORF, DONALD, New Castle, Del.
ONNEN, DONALD S., Erie, Pa.
PACQUER, ROBERT E., Seattle, Wash.
PALMENBERG, EDWARD C., Manuet, N. Y.

(*ASME News continued on page 1172*)



YARWAYS for WICKES



this package boiler maker selects Yarway Blow-Off Valves

The Wickes Boiler Co. selects Yarway Seatless Blow-Off Valves to make their good package-type boiler even *better*.

Most package boiler users insist on Yarways . . . and most boiler manufacturers supply them. This acceptance is growing fast. *Dependability* and *low maintenance* are two of the reasons. Rugged, safe Yarway Seatless Blow-Off Valves *have no seat to score, wear, clog or leak.*

Yarway Blow-Off Valves are used today in over 16,000 boiler plants. Many of these valves have been in *continuous* service 20, 30 and 40 years.

For the full story on blow-off valves to meet your pressure requirements, write for Yarway Bulletin B-426.

YARNALL-WARING COMPANY

108 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES in PRINCIPAL CITIES

YARWAY

BLOW-OFF VALVES

PARTINGTON, ALBERT J., Kansas City, Mo.
PAWLAK, EDWARD M., Roselle Park, N. J.
PEARSALL, LEON M., Charlotte, N. C.
PICHA, KENNETH G., Atlanta, Ga.
PREDALE, JOHN O., Newark, N. J.
PURI, ZAFAR I., New York, N. Y.
RACK, HERMAN A., Rahway, N. J.
RANG, EDWARD R., Minneapolis, Minn.
RISING, EDWARD J., Manhattan, Kan.
RITTENHOUSE, GEORGE B., Rosemont, Pa.
ROSCH, MELVILLE W., Old Greenwich, Conn.
RUBIO, ABDON, Schenectady, N. Y.
SAMMET, ERWIN H., South Euclid, Ohio
SCHOFER, NATHAN, Wichita, Kan.
SCOWCROFT, WALTER, Palos Heights, Ill.
SHAPIRO, ALVIN, West Allis, Wis.
SHORT, PHILIP H., Shreveport, La.
SIEGFRIED, JOSEPH H., JR., Berkeley, Calif.
SILVERMAN, MORRIS, Philadelphia, Pa.
SMITH, NORMAN J., Churchville, Pa.
SONDHI, RAJ K., New Delhi, India
SPATAFORE, EMIL, Waterbury, Conn.
STORY, PAUL E., Kauai, T. H.
THOMAS, JOSEPH J., Pittsburgh, Pa.
THOMAS, RICHARD L., Charleston, W. Va.
TILLSTROM, CARL L., El Dorado, Ark.
TRINER, NEIL H., Newington, Conn.
TRIVEDI, KENTILAL D., Nagpur, M. P., India
VAN DER SPEK, JEAN H., Brussels, Belgium
VAN DYKE, BURTON, Louisville, Ky.
VANECH, NICHOLAS V., Valley Stream, N. Y.
WARRICK, EDWARD C., Pittsburgh, Pa.
WEBB, WILLIAM D., Wilmington, Del.
WENTZEL, WARREN W., Hazleton, Pa.
WILDING, JOHN D., Keyport, N. J.
WILLIAMS, MELVIN O., JR., Cincinnati, Ohio
WINTER, PAUL H., Syracuse, N. Y.
WITT, RAYMOND C., Freeport, Texas
ZEBARTH, RALPH E., Bloomington, Ill.
ZWEIER, IRVING, Baltimore, Md.

Change in Grading

Transfer to Member or Affiliate

BARTHA, WILLIAM A., Jamesburg, N. J.
BORETZ, JONATHAN E., Bayshore, L. I., N. Y.
CARLE, EDWARD J., Richmond, Va.
CARRIER, GEORGE F., Cambridge, Mass.
COOLEY, WILLIAM H., Seattle, Wash.
EDMUND, JOHN R., Berkeley, Calif.
ELLIS, BRYAN A., Edmonton, Alta., Can.
FIELD, VERNON M., Livermore, Calif.
FOSTER, EUGENE L., Still River, Mass.
GOCKLEY, GENE H., Allentown, Pa.
HARRIS, HERBERT R., Malverne, N. Y.
HATHAWAY, CHARLES A., Litchfield, Conn.
HORRICKS, J. ROBERT, La Tuque, P. Q., Can.
IVERSON, HAROLD W., Berkeley, Calif.
KEHN, DONALD F., New York, N. Y.
KIRKPATRICK, EDWARD T., Pittsburgh, Pa.
LIST, LEWIS S., Valley Stream, N. Y.
LOVEJOY, STANLEY W., JR., Levittown, N. Y.
MASNIK, WALTER, Perth Amboy, N. J.
REID, JAMES W., Collingswood, N. J.
REINAUER, THOMAS V., Westfield, N. J.
ROESSLER, CARL A., Kingsport, Tenn.
RUMBAUGH, ERNEST C., Scotia, N. Y.
SWANSON, JACOB B., JR., Baton Rouge, La.
TRIVIZ, PETER F., La Romana, Dominican Republic
VERSCHOOR, JACK D., Manville, N. J.
WAGNER, WILLIAM A., Scio, Ohio
WEBER, HENRY F., Warwick, Va.
WEHE, ROBERT L., Ithaca, N. Y.
WERNECKE, HEINZ C., Bangor, Mich.
WOODBURY, RODERICK V., Neponset, Mass.

Transfers from Student Member to Associate Member 56

Obituaries . . .

Edward Stanley Beaty (1924–1955), manager, Korea Oil Storage Co., Seoul, Korea, died June 10, 1955. Born, Beaumont, Texas, May 15, 1924. Parents, George D. and Margaret (Thoma) Beaty. Education, BS(ME), The Rice Institute, 1944. Assoc. Mem. ASME, 1947. Survived by parents.

Francis Bigelow Blackstone (1907–1955), division superintendent of power plants, Freeport Sulphur Co., Port Sulphur, La., died Aug. 7, 1955. Born, Sac City, Iowa, May 21, 1907. Parents, Bigelow P. and Maude (Crompton) Blackstone. Education, BS, The Rice Institute, 1929; ME, The Rice Institute, 1932. Jun. ASME, 1929; Mem. ASME, 1940.

Eugene Arthur Coupal (1886–1955), tool engineer, Holtzer-Cabot Co., Boston, Mass., died Feb. 19, 1955. Born, Boston, Mass., Jan. 4, 1886. Parents, Peter A. and Mary Emma (Bourdelais) Coupal. Education, graduate, Mechanic Arts High School; attended, Massachusetts Institute of Technology. Married Grace Lincoln McKenny, 1941. Held U. S. Patents on methods of making boots and automatic staple-welting machines. Mem. ASME, 1946. Survived by wife.

Mortimer Hasell Courtenay (1897–1955), district manager, SKF Industries, Inc., Atlanta, Ga., died some time in 1955 according to information received by ASME. Born, Charleston, S. C., Feb. 22, 1897. Parents, Gilman and Katherine (Hasell) Courtenay. Education, attended Georgia Institute of Technology. Married Felicia Tolly, 1924; children, Linda and Nina Courtenay. Mem. ASME, 1936.

Harry Fredrick Day (1909–1955), chief estimator, Reynolds Tobacco Co., Winston-Salem, N. C., died Aug. 9, 1955. Born, Winston-Salem, N. C., Aug. 18, 1909. Parents, Jerome H. and Trula (Miller) Day. Education, BS (ME), University of Kentucky, 1932. Married Elizabeth O. Jones, 1939. Mem. ASME, 1950. Survived by mother; wife; three sons, Harry F. Jr., Charles S., and Michael F.; two brothers, J. Francis Day and Jerome Day, and one sister, Mrs. Halbert Leet.

Emory De Nador (1897–1955), chief engineer, Lyon, Inc., Detroit, Mich., died Jan. 8, 1955. Born, Szekszard, Hungary, Sept. 21, 1897. Education, ME, Technical University, Budapest, Hungary, 1921; EE, Polytechnicum, Vienna, Austria, 1923; thermodynamics, Polytechnic, Zurich, Switzerland, 1924. Held joint patent with Henry Ford. Mem. ASME, 1948.

Robert Edgar Ford (1874–1955), partner, Luthor Ford & Co., Minneapolis, Minn., died May, 1955. Born, Allentown, Pa., June 12, 1874. Education, BEE, University of Minnesota, 1895; EE, 1900. Mem. ASME, 1919.

Evert Wendell Freeman (1898–1955), plant engineer, Brown & Sharpe Manufacturing Co., Providence, R. I.; vice-president National Ring Traveler Co., died in Boston, Mass., March 9, 1955. Born, Providence, R. I., Oct. 19, 1898. Parents, John R. and Elizabeth (Clark) Freeman. Education, BS, Massachusetts Institute of Technology, 1920. Married Marion Baker. Assoc. Mem. ASME, 1930; Mem. ASME, 1935. Survived by wife.

Kirtland Cutter Gardner (1876–1955), president and general manager, United Engineering & Foundry Co., Pittsburgh, Pa., died April 15, 1955. Born, Cleveland, Ohio, Aug. 5, 1876. Parents, George W. and Rosaline (Oviatt) Gardner. Education, Case School of Applied Science, 1897. Married Myrta Eugenia Newbauer, 1901; children, Mary, Isabel, Kirtland, Jr., Louise, George F. Held U. S. Patents. Mem. ASME, 1941.

John Edward Griner (1925–1951), field research engineer, Caterpillar Tractor Co., Peoria, Ill., died July 29, 1951, while serving in Armed Forces. Born, South Bend, Ind., Feb. 5, 1925. Parents, Otis E. and Edna (Boyle) Griner. Education, BME, Purdue University, 1945. Assoc. Mem. ASME, 1945. Survived by mother.

Leon Noble Hampton (1895–1955), engineering supervisor, Bell Telephone Laboratories, Inc., Pleasantville, N. Y., died March 5, 1955. Born, New York, N. Y., March 7, 1895. Parents, George and Lillian (Quinn) Hampton. Education, attended Cooper Union Institute of Technology. Married Margaret Wilcox, 1917; wife died, 1954. Invented card translator which facilitates dialing a long-distance call. Cited by General Electric Co. for his direction of the development of soldering copper, 1940. Assoc. Mem. ASME, 1923; Mem. ASME, 1935.

William Charles Hansen (1894–1955), president, A. Stucki Co., Pittsburgh, Pa., died Jan. 27, 1955. Born, Pittsburgh, Pa., Aug. 17, 1894. Parents, William E. and Anna (Bauss) Hansen. Education, BS(Ch), University of Michigan, 1917. Married Emma Stucki, 1921. Mem. ASME, 1947. Survived by wife; two daughters, Mrs. E. William Cummings, Saginaw, Mich.; Mrs. Thomas D. Cramer, Ben Avon, Pittsburgh, Pa.; and a son, William S., Assoc. Mem. ASME, Ben Avon, Pa.

William Edwin Heagle (1901–1954), factory manager, Allock Manufacturing Co., Ossining, N. Y., died Nov. 1, 1954. Born, Ossining, N. Y., Oct. 1, 1901. Parents, William and Emeline (Tompkins) Heagle. Education, ME, Stevens Institute of Technology, 1923. Married Helen Fort, 1927. Assoc. Mem. ASME, 1923. Survived by wife and son, Peter Douw Heagle.

Frederick Davis Herbert (1873–1955), president, Kearfott Co., Inc., Little Falls, N. J., died Aug. 4, 1955. Born, Brooklyn, N. Y., Oct. 16, 1873. Parents, Wilbur F. and Charlotte (Weeks) Herbert. Education, MB, Cornell University. Married Jane Whittlesey Mitchell, 1903. Honorary member, Society of Naval Architects and Marine Engineers. Jun. ASME, 1899, Mem. ASME, 1907, Fellow, ASME, 1941. Survived by wife; four sons, Frederick D., Jr., John M., Sidney P., and Wilbur F.; two daughters, Mrs. W. Almon Stopford and Mrs. Philip du Quesnay, and sixteen grandchildren.

Ivar Laurits Langvand (1882–1955), consulting engineer, The Babcock & Wilcox Co., Barberton, Ohio, died Feb. 28, 1955. Born, Volden, Norway, Jan. 11, 1882. Parents, Lars J. and Rasmine S. Langvand. Education, graduate, Carl Johans Vaerns Tekniske Skole, Horten, Norway. Naturalized U. S. citizen, Akron, Ohio, 1916. Married B. Pearl Mellinger, 1913. Assoc. ASME, 1909. Survived by wife and daughter, Mrs. Kent R. Spelman, Cleveland, Ohio.

Richard Henry Libbey (1884–1955), consultant West Acton, Mass., died in March, 1955, at the Emerson Hospital, Concord, Mass. Born, Manchester, N. H., April 18, 1884. Parents, Henry and Minnie (Bowen) Libbey. Education, Somerville, Mass., public schools; American School of Correspondence. Married Cora E. King. Jun. ASME, 1913; Mem. ASME, 1917. Survived by wife.

Henry Charles Edward Meyer (1884–1955), chief engineer, Gibbs & Cox, Inc., New York, N. Y., died Aug. 18, 1955. Born, Antwerp, Belgium, April 3, 1884. Parents, Daniel and Marie Barbara Therese (Hulet) Meyer. Education, public and technical schools, Holland, England, Belgium, and United States. Married Hazel Lawrence O'Brien, 1916. Received commendation from the U. S. Navy Bureau of Ships for work which helped make possible mass production of Liberty and Victory Ships, 1947; awarded the Captain Linnard Prize by the Society of Naval Architects and Marine Engineers for paper on high-pressure steam piping, 1950. Mem. ASME, 1921. Survived by wife.

Crayton L. Norris (1905–1955), senior mechanical engineer, Tennessee Valley Authority, Knoxville, Tenn., died Aug. 11, 1955. Born, Verbena, Ala., Dec. 21, 1905. Parents, Ethan A. and Callie (Robinson) Norris. Education, AB, Howard College, 1924. Married Nabetha Young, 1928. Mem. ASME, 1946. Survived by wife and two children, Carol Ann and David Lee.

John Orr (1870–1955?), retired professor of engineering, Transvaal University, Johannesburg, Union of South Africa, died according to information recently sent to the Society. Born, Torrance, Lanarkshire, Scotland, April 25, 1870. Education, attended Glasgow Technical College; Glasgow, Scotland; Coatbridge Technical School & Mining College, Scotland; BS, Glasgow University, Glasgow, Scotland, 1896. Elected honorary life president of South African Standards Institute, 1946. Mem. ASME, 1909.

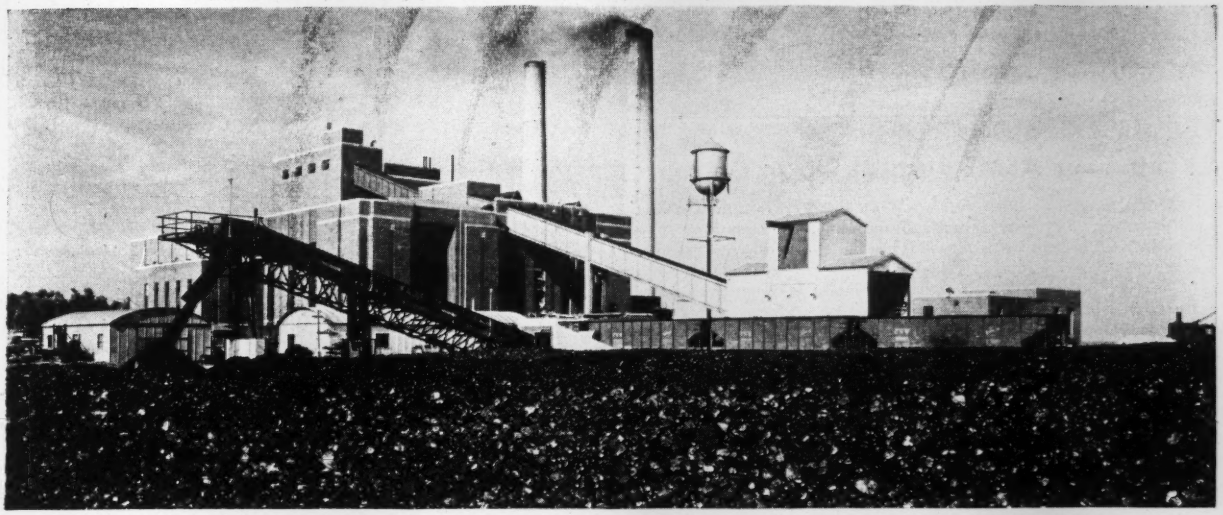
Louis Ortner (1874–1955), retired in 1939 as chief engineer, Department of Hospitals, New York, N. Y., died July 30, 1955. Born, Austria, Nov. 5, 1874. Parents, George and Carolyn (Schmithofer) Ortner. Education, ME, Lehigh University, 1900. Married Lillian Meiss, 1906 (died 1954). Mem. ASME, 1913. Survived by two sons, Louis G., Brooklyn, N. Y.; Rev. John M. Ortner, S. J., Le Moyne College, Syracuse, N. Y.; and four daughters, Sister M. St. John, I.H.M., St. Mary's Convent, Manhasset, L. I.; Helen C., Brooklyn, N. Y.; Sister M. Alois, I.H.M., St. John's Convent, Pittston, Pa.; and Mrs. Charles Demuth, Ramsey, N. J.

Armand Valere Pretot (1899–1955), staff engineer, Johns Manville Corp., New York, N. Y., died Feb. 6, 1955. Born, Newark, N. J., Nov. 1, 1899. Parents, Valere and Fanny Pretot. Education, attended Newark Technical School. Married Myrtle L. Hankins, 1924. Married 2nd, Ilona Howarth, 1952. Held patents on office partitions and small-house construction. Jun. ASME, 1925; Assoc-Mem. ASME, 1932; Mem. ASME, 1935. Survived by wife; one daughter, Jacqueline Pretot; and son, Armand Pretot.

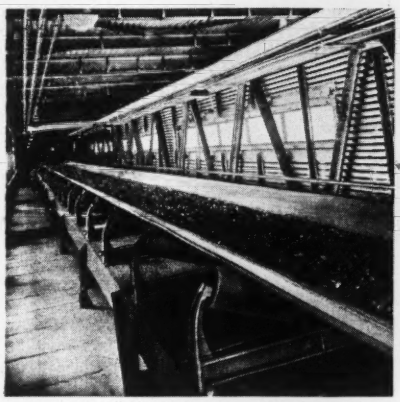
John Primrose (1873–1955), vice-chairman, Foster Wheeler Corp., died Aug. 11, 1955. Born, Pictou, Nova Scotia, Can., May 27, 1873. Parents, Howard and Olivia Primrose. Education, BA, McGill University, 1895. Married Eleanor Girouard. Mem. ASME, 1907. Survived by wife; two daughters, Mrs. Andrew M. Clarke and Mrs. W. A. Euler; five grandchildren and three stepchildren.

Charles Bemis Rearick (1870–1955), owner, Charles B. Rearick Firm, died Aug. 22, 1955. Born, St. Louis, Mo., Oct. 6, 1870. Parents,

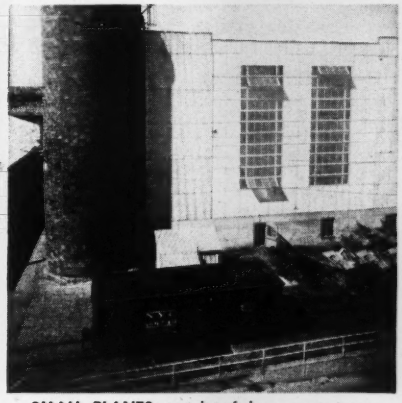
(*ASME News continued on page 1174*)



RECENTLY ENLARGED BY ⅔, this Midwest power plant underwent minimum rearrangement. Coal distribution equipment was extended to serve new bunkers as well as original Link-Belt system installed in 1931. Stacker in yard piles 30,000-ton reserve.



12-HOUR CHANGEOVER to fuel two additional generating units was accomplished in revamping this coal handling system.



SMALL PLANTS restricted in area get expandability plus efficient utilization of initial equipment from Link-Belt designs.

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when Link-Belt provides for low-cost expansion of capacity

THE growth of populations and industry usually demands provision for coal handling expansion in the initial plans of power stations and boiler houses. Link-Belt has helped meet that need, with consideration for location, transportation facilities, reserve storage needs and other special problems.

With its broad line of equipment, Link-Belt offers a single source for feeders, elevators, conveyors, stackers—whatever you need for lowest per-ton handling costs. In addition, Link-Belt engineering can adapt the lessons taught by thousands of installations to your individual requirements.

Working with your consultants, Link-Belt is equipped to accept full responsibility for design, fabrication, erection and satisfactory performance of your entire system. Or, if you need only a single conveyor, call your nearest Link-Belt office for prompt, expert service. LINK-BELT COMPANY, Dept. AV, 307 N. Michigan Ave., Chicago 1, Ill.

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Charles D. and Lucretia (White) Rearick. Education, attended Washington University. Married Anna J. Stepper, 1903. Jun. ASME, 1892; Mem. ASME, 1902.

Jerry Healand Reeves, Jr. (1904–1955), district manager, Westinghouse Electric Corp., Charlotte, N. C., died in an automobile accident, March 28, 1955. Born, Eufaula, Ala., Aug. 25, 1904. Parents, Jerry H. and Antoinette Margaret Reeves. Education, EE, Alabama Polytechnic Institute, 1925. Married Zeadora Breckenridge, 1930. Mem. ASME, 1945. Survived by wife and two sons, Jerry Healand Reeves, 3rd., Savannah, Ga.; Lieut. John B. Reeves, Kinston, N. C.; a daughter, Jacqueline Anne; and two grandsons.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

ASME Master-File Information

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Name of employer .....

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Product or service of company .....

Title of position held .....

Nature of work done .....

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Publication	*Address changes effective when received prior to:*
☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

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☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ S—Power
☐ C—Management	☐ L—Process Industries	☐ T—Textile
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
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☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	

Alexander George Rykov (1908–1955), head of engineering division, Dept. of Public Works, U. S. Naval Station, San Juan, Puerto Rico, died July 24, 1955. Born, Kopyczynce, Podol, Poland, Sept. 6, 1908. Parents, Hyman and Amalia Auerbach. Education, ME, Institute of Technology-University, Prague, Czechoslovakia, 1937. Naturalized U. S. citizen, 1945. Married Ellen Epstein, 1948. Commended by Chief, Bureau of Yards and Docks, Navy Dept., Washington, D. C., for outstanding performance in an investigation of fraud committed against the U. S. Government, 1953. Mem. ASME, 1949. Survived by wife.

Elliot Alfred Santon (1881–1954), mechanical engineer, Crompton & Knowles Loom Works, Worcester, Mass., died May 28, 1954. Born, Worcester, Mass., Oct. 7, 1881. Parents, Moses E. and Lucy Jane Santon. Education, high-school graduate; correspondence courses in engineering. Married Clara E. Willis, 1910. Mem. ASME, 1949. Survived by wife; a daughter, Mrs. Charlotte Mitchell; and two grandchildren.

William Abbott Sibson (1897–1955), power and utilities engineer, Socony Mobil Oil Co., Inc., died Aug. 17, 1955. Born, Philadelphia, Pa., Dec. 30, 1897. Parents, Walker W. and Louise (Abbott) Sibson. Education, attended The Pennsylvania State College, and Drexel Institute. Married Grace Miller, 1932. Mem. ASME, 1944. Survived by wife.

S. Granville Smith (1898–1954), managing partner, Granville Smith & Associates, Chicago, Ill., died Aug. 29, 1954. Born, New York, N. Y., July 4, 1898. Education, Minerva Tech. Prep., Zurich, Switzerland, 1916. Mem. ASME, 1947.

William Manning Smith (1896–1955), mechanical engineer, Sanderson & Porter, New York, N. Y., died July 28, 1955. Born, Almonte, Ont., Can., Feb. 25, 1896. Parents, John and Lillian (Manning) Smith. Education, ME, New York University, 1929. Married Lillian Burk, 1923 (died 1929). Married 2nd, Florence Newman, 1938. Mem. ASME, 1936. Survived by wife.

Agnew Allen Talcott (1908–1955), receiver, Dagmar Chemical Co., Glenbrook, Conn., died March 21, 1955. Born, New York, N. Y., Feb. 20, 1908. Parents, Allen B. and Katherine (Agnew) Talcott. Education, attended Dartmouth and Massachusetts Institute of Technology. Married Charlotte Smith, 1931; daughter, Priscilla. Married, 2nd, Shirley Whitney, 1948. Jun. ASME, 1932.

Stephen John Thompson (1875–1955), governing director, John Thompson Motor Pressings Ltd., Wolverhampton, England, died April 30, 1955. Born, Wolverhampton, England, Dec. 20, 1875. Education, Wolverhampton Grammar and Technical Schools. He was a member of Council, The Institution of Mechanical Engineers. Mem. ASME, 1925.

Julius Tiesler (1902–1955), retired as vice-president, Dallett Co., Philadelphia, Pa., died March 10, 1955. Born, Nehein, Westphalia, Germany, July 18, 1902. Parents, Robert and Elisabet (Kemper) Tiesler. Education, ME, College of Engineering, Bingen on the Rhine, Germany, 1922; Metallurgy, Temple University, 1936. Married Lottie B. Tulish, 1934. Mem. ASME, 1943. Survived by wife.

Louis Lester West (1900–1955), chief engineer, Gries Reproduction Corp., New Rochelle, N. Y., died Aug. 12, 1955. Born, Hungary, June 16, 1900. Education, BS, Cooper Union Institute of Technology, 1925. Jun. ASME, 1925; Mem. ASME, 1936. Survived by wife and son, Robert.

Lloyd M. Zimmerman (1902–1955), president, Associated Zimmerman Engineers, Kaukauna, Wis., died some time in 1955, according to information received by ASME. Born, La Porte, Ind., June 12, 1902. Education, attended University of Chicago. Assoc. ASME, 1945.

Francis Joseph Zircher (1913–1955), sales and service manager, Woodward Governor Co., Rockford, Ill., died July 20, 1955. Born, Rockford, Ill., Feb. 27, 1913. Parents, Mr. and Mrs. Joseph Zircher. Education, ME, Purdue University, 1937. Jun. ASME, 1937.